Report of Technical Advisory Group Workshop on Planning for the Medium-Long Term[1] IWC-POWER Programme

Tokyo, 24-26 January 2024

1. INTRODUCTORY ITEMS

The 2024 IWC-POWER Technical Advisory Group (TAG) workshop was held at the Sanbancho Conference Hall, Tokyo, from 24-26 January 2024. The original workshop that had been scheduled for 17-21 October 2023 in Tokyo, Japan was postponed from October because US Scientists were unable to travel at that time. Given the need to submit a permit request to the US Government at the end of 2023, the planning meeting for the 2024 cruise (that was originally intended to take place alongside the TAG) was held in a hybrid format 17-19 October 2023 and run from the Alaska Fisheries Science Center in Seattle, WA, USA (SC/69BREP01A).

The list of participants to the present workshop is given as Annex A.

Before the start of the workshop, the participants held a minute's silence in the memory of Dr Yoshida of NRIFSF, who sadly died during the last Scientific Committee meeting in Bled. Dr Kato and Dr Brownell Jr reminded us of the great contribution that Dr Yoshida had made, not only to the IWC-POWER programme but also to the work of the Scientific Committee in general since his first meeting in 2000. He also made many contributions to international research, especially with scientists in the Russian Federation, the Republic of Korea, the Caribbean and West Africa. His work on cetacean genetics, especially of finless porpoises and Bryde's whales, were of major importance.

1.1 Opening remarks and welcoming address

Matsuoka welcomed the participants to the Workshop and expressed thanks to the IWC and the governments of Japan and the USA for the recent successful collaborative IWC-POWER surveys. He thanked the Fisheries Agency of Japan for hosting the physical component of this hybrid meeting and hoped for a productive and successful meeting. He highlighted that the objective for the next three days was to discuss the completion of Phase I[1] of the IWC-POWER programme and continue planning for Phase II.

Iida, Assistant Director, Whaling Affairs Office, Fisheries Agency of Japan thanked and welcomed the participants on behalf of the Japanese government. He noted that the IWC-POWER programme, with its broad coverage of the North Pacific Ocean and with participation of experts from several countries, has made a substantial contribution to the development of scientific knowledge and evidence for proper conservation and management of large whales in the North Pacific. Given its outstanding scientific significance and development, Japan was proud of having co-sponsored the IWC-POWER programme over the last 14 years. He reiterated thanks to all who have worked for the IWC-POWER programme. Whilst Japan is no longer a member of the IWC, the Government is willing to continue the IWC-POWER programme under a co-operative relationship with the IWC Scientific Committee and its scientists. Japan is looking forward to discussing the future direction of the IWC-POWER programme during this meeting.

Staniland, IWC Secretariat, expressed great pleasure to be in Tokyo in-person and thanked everyone attending the meeting. He commended the expertise and dedication of participants as one of the main reasons for the success of the IWC-POWER research programme. He identified one of the great joys of working with the IWC is seeing scientists from all over the world working together to further our understanding of cetaceans.

On behalf of the IWC, he sincerely thanked the Government of Japan for its ongoing support in not only providing a vessel and crew to carry out these vital surveys but also their dedicated scientists. The information provided by this programme feeds directly into the work of the IWC Scientific Committee and underpins the advice it provides on North Pacific cetaceans.

Given the IWC-POWER programme has now successfully surveyed all the accessible areas within the North Pacific, he emphasised this meeting will focus on the important task of setting the objectives and planning for Phase II and looked forward to a productive three days and a successful meeting.

---

[1] Recognising that the 'short-term' phase of the IWC-POWER programme is approaching completion, the TAG **agrees** that the 'short-term' phase will now be called Phase I and that henceforth the 'medium-term' component of the programme will be called Phase II. Phase II will begin in 2026.

1.2 Election of Chair and rapporteurs

Matsuoka and Kitakado shared the Chair. Donovan, Lang, Staniland and Palka acted as rapporteurs.

1.3 Adoption of Agenda

The adopted agenda is shown as Annex B.

1.4 Review of available documents

The list of documents is given as Annex C. A summary of the 2023 cruise (full report is WP05) is included as Annex D. Relevant issues are dealt with under the relevant agenda items below.

2. REVIEW OF DISCUSSIONS BY THE SCIENTIFIC COMMITTEE AT SC/69A

The IWC agreed (IWC, 2012) that the long-term IWC-POWER programme

> 'will provide information to allow determination of the status of populations (and thus stock structure is inherently important) of large whales that are found in North Pacific waters and provide the necessary scientific background for appropriate conservation and management actions. The programme will primarily contribute information on abundance and trends in abundance of populations of large whales and try to identify the causes of any trends should these occur. The programme will learn from both the successes and weaknesses of past national and international programmes and cruises, including the IDCR/SOWER programme.'

Last year (IWC, 2024), the Scientific Committee reiterated the great value of data contributed by the IWC-POWER cruises that have covered many regions of the North Pacific Ocean not otherwise surveyed in recent decades. The programme addresses important information gaps for several species and has contributed greatly to the Committee's ongoing assessment work. The Committee endorsed the report of the Steering Group (SC/69A/REP/03A; SC/69A/REP/03B) and recommended that the programme continues. It encouraged all member governments and range states to support IWC-POWER, either financially or in-kind, to further enhance the value of the programme.

2.1 Phase I options (incl. information gaps)

The Phase I objective for the IWC-POWER programme had been to focus on the 'least studied' areas of the central and Eastern North Pacific taking into account national programmes. Much of these areas had now been covered with the notable exception of Russian waters (see Fig.1). The TAG **agrees** that the present political situation means that there is no likelihood that IWC-POWER will be granted permission to operate in Russian waters for several years. Regretfully, it considered that the Russian waters component of Phase I must be abandoned for the present, whilst recognising that cruise plans for those waters are available (refs) and that these can be implemented if and when circumstances become favourable. It **agrees** that after the completion of the 2024 and 2025 cruises (see SC/69BREP01A), Phase 1 can be considered effectively complete.

2.2 Medium and long-term (incl. information gaps)

In 2023, the Committee endorsed the updated medium-term objectives provided in SC/69A/REP03A. It agreed that the planning for the next phase of the IWC-POWER programme should continue. In addition to the work undertaken in Phase 1, the Committee had agreed that future cruises should have an emphasis on participation from all range states and also include consideration of more methodologically focussed cruises in some years (e.g. use of a towed acoustic array, telemetry work, use of SeaGlider etc.).

The TAG noted these comments and they were taken into account in its discussions, in particular under Item 7.

3. OBJECTIVES OF THE WORKSHOP

The primary focus of the Workshop was to continue the planning for the next phase of IWC-POWER (medium to long-term) by:

> (1) updating the previous general (Item 4) and species-specific outcomes (Item 5) developed last year (SC/69A/REP03A) to date of the almost complete Phase I;
>
> (2) reviewing progress on already identified analyses (and identifying any additional analyses) required to complete planning for Phase II (see Item 9.4, Table 2);
>
> (3) review the Phase 2 objectives agreed last year (SC/69A/REP03A) taking into account the results of any new analyses and provide a broad outline of what Phase 2 might look like with a view to finalising this at the next TAG meeting (expected to be held in November 2025).

4. GENERAL SURVEY APPROACHES USED TO DATE (2010-2023)

The TAG welcomed the provision of Annex E that summarises the cruises undertaken to date and formed an important component of the discussions below. It also welcomed the presentation by Katsumata of an outline of a broad overview paper that will incorporate the fundamental information obtained under Phase I. It was agreed that individual TAG members will provide suggestions and comments to Katsumata to assist in the development of the paper intersessionally. The TAG will review a revised draft of the paper at its next meeting.

4.1 Primary and secondary objectives of surveys related to field and analytical methods used given available resources

The aim of the first phase of IWC-POWER was to obtain baseline data on the distribution and abundance of cetaceans in the 'least studied' areas of the central and Eastern North Pacific with the focus on large whales but collecting data on other cetaceans and marine debris. During these surveys, data and samples were collected to assist in clarifying stock structure. This will facilitate determination of appropriate management units (units-to-conserve) to inform the elucidation of status and the need if any for actions to reduce anthropogenic pressures that might negatively affect status. Given the lack of knowledge of the present situation in these areas, the initial aim was to cover them as quickly as possible given the resources available, such that the information obtained would guide the development of a Phase II strategy to allow the overall long-term objectives (see Item 2) to eventually be met.

4.2 Distribution and abundance

4.2.1 Choice of survey areas and cruise track design

Fig. 1 shows the survey areas covered to date and those anticipated to be covered to complete the first phase of IWC-POWER in 2026. The choice of survey areas and strata was largely pragmatic based upon the number of days the vessel was available and transit times but included consideration of historical distribution and densities of the high priority species (see Item 7.1, Table 1) based upon examination of whaling data and past (1965-82) information from Japanese scouting vessels – see SC/63/Rep5. Some areas have been covered more than once, given the problems in obtaining permits to enter Russian waters but comparison of these will assist in developing Phase II. It should be noted that initially, Bryde's whales were not considered a priority species for IWC-POWER (see SC/63/Rep5) but this was later revised on the advice of the Scientific Committee and hence the areas south of 40N were surveyed from 2013-2016. The fundamental approach to obtain information on distribution and abundance was line-transect survey; cruise design followed standard practice i.e. equal coverage probability using program DISTANCE and a random start point. Valuable information on the distribution/occurrence of cetacean species in these poorly studied areas has been obtained from sightings data and this is summarised by species for the large whales under Item 5.

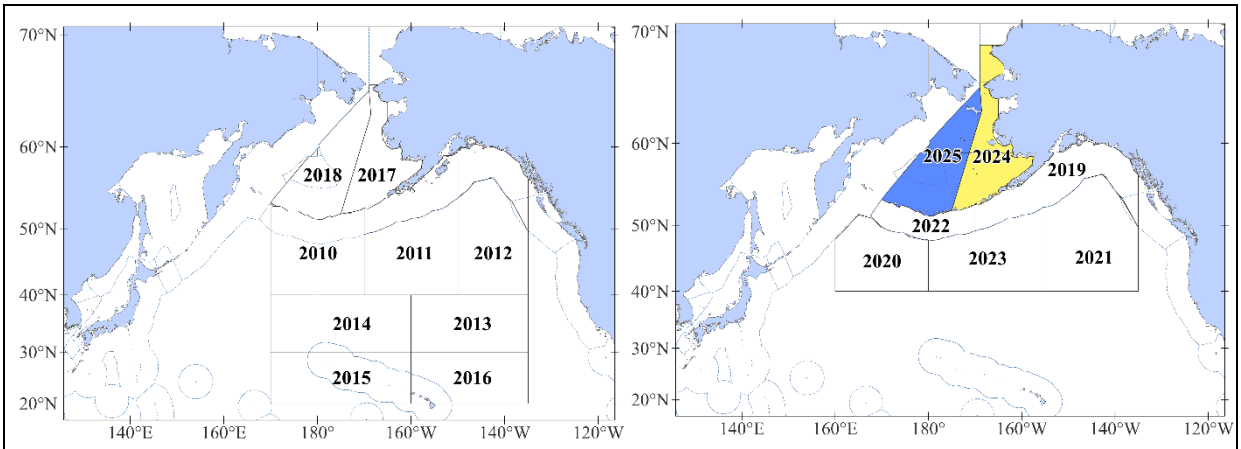


Fig. 1 Survey areas covered to date by year and those anticipated to be covered in the remaining first phase of IWC-POWER. Discussion of the 2024 and 2025 cruises can be found in SC/69B/Rep1A

4.2.2 Survey methods for Distance sampling (including survey modes, distance and angle experiments) and analytical approaches (design-based and spatial approaches)

4.2.2.1 SURVEY MODE

From 2010-2016, the surveys were carried out in 'NSP' mode (passing mode with abeam closing) that was believed to be the most appropriate given the priority species and the need to close to confirm species identity

and group size (as well as to obtain biopsy samples and photographs). Later, it became apparent that the assumption that $g(0)$ is close to one for the larger whales might not be applicable and so since 2017, the survey mode has changed to alternating between NSP and double platform (IO) mode (usually around every 50 n.miles on effort but at the discretion of the cruise leader depending *inter alia* on the density of sightings – IO is not practical in high density areas). Although it had been expected that the full analysis of these data (for all species for which there is a sufficient sample size) would be available at this meeting this had not proved possible. The results of these analyses will form an essential contribution to determining the most appropriate survey mode strategy or strategies (it may vary by area/target species) for the next phase of IWC-POWER. The TAG **stressed** that completing these analyses is a high priority. How best to facilitate this is discussed further under Item 9.4 (see Table 2).

4.2.2.2 DISTANCE AND ANGLE EXPERIMENTS

DISTANCE based analyses require unbiassed and precise estimates of the position of sighted animals from the trackline (obtained by estimating the distance and angle to the sighting). Any inaccuracies in the distance and angle observations can introduce biases in the effective search width, subsequently impacting population density and abundance estimates. It is therefore important that experiments are conducted to estimate the ability of the relevant crew and researchers to do this (ideally under a range of sightings conditions). All cruises to date have undertaken Distance and Angle Experiments (DAEs) and an improved experimental method was introduced in 2015 (SC/66b/Rep02). Analysis of these data has been a TAG priority.

Routinely, a standard linear regression model with an intercept fixed at zero for the 'perpendicular distance' has been employed for each platform annually, although the actual measurements are recorded for the 'radial distance' and 'angle'.

Kitakado and Matsuoka introduced WP10, which conducted a comprehensive review of data from the DAEs carried out during the IWC-POWER surveys from 2010 to 2022. The analyses focused on: (1) which probability distribution is appropriate for each type of measurement; (2) what sighting conditions influence the error; (3) whether and if so to what extent the observations are biassed; and (4) whether corrections should be applied for the radial distance and angle directly rather than for the resultant perpendicular distances? The results presented indicated that (1) a gamma distribution, which has a constant CV and increased variance with the mean radial distance, showed a better fit to the radial distance data; normal distributions are options for angle and perpendicular distance; (2) sighting conditions have less influence than the year effect; (3) the measurements are almost unbiased, with a slightly increased bias and variance for the radial distance with the increase of true radial distance, while the angle data are independent from the radial distance and have a constant variance; (4) the small expected bias assessed by the perpendicular distance (the routine approach) tends to be similar to the expected bias quantified by the two measurement models for the radial distance and angle, supporting the current routine approach for correction. Nevertheless, even if there is no bias in the observed perpendicular distance or correction can be made successfully, the variance of the distance data may result in some bias in the abundance estimation, indicating the importance of continued DAEs in the survey to maintain or reduce the variation.

The TAG welcomed this thorough improved analysis. It noted that the initial cue of the animal (body versus blow) during the actual surveys has an influence on the accuracy of the distance estimate. If the test buoy is close to the ship, it can be considered to represent a sighting where the body is the cue, whereas if it is far away it can be considered to represent a sighting where the blow was the cue. The TAG suggests the final analyses of the DAE data investigate if this factor influences the bias or precision of the recorded radial distance and angle. It is also valuable to investigate the influence of the results on the overall CVs of the final abundance estimates. Given the importance of the results of this DAE outside the IWC-POWER programme, the TAG **recommends** this paper be submitted to SC69B and subsequently to a peer-reviewed journal.

The TAG looks forward to the final results of the analysis and **agrees** that:

(1) such experiments must be held for each future cruise where DISTANCE sampling is undertaken in accordance with IWC guidelines; and

(2) methods used to determine distance and angle at sea should continue to be reviewed in light of potential new methods and technology.

4.2.2.3 ESTIMATES

The line transect data provide an estimate of the number of animals present in the study area at the time of the survey. For the baleen whales, the areas covered by IWC-POWER usually represent feeding areas. It should be noted that there may be more than one population of any particular species within the survey area. It is also

important to consider the timing of the surveys if comparing across years for the same geographical area when interpreting differences. For example, the cruises in the period up to 2016 took place in July and August whilst the surveys since 2017 have taken place in August and September. Note that this does not necessarily invalidate comparisons but this possibility should be considered in any analyses.

To date, the primary analytical approach has been to produce standard design-based estimates of abundance as yet not corrected for $g(0)$ or taking into account additional variance although this work is underway. Estimates by species are considered where appropriate under Item 5. The TAG **reiterated** the importance of obtaining design-based estimates, corrected for $g(0)$ where possible, for Phase I both for completion and to inform Phase II. This is discussed further under workplan (Items 7, 9.4 and Table 2).

The value of using spatial modelling approaches to estimate abundance and produce density maps is increasingly recognised. Where successful, this can reduce CVs and provide insights into those factors of importance in determining why animals are distributed where they are within the study areas. This is especially important in the light of additional variance and potential changes in distribution (and thus abundance estimates in the same areas in different years) due to environmental changes. This may directly affect our ability to estimate trends – a key component of the Phase II and beyond objectives of IWC-POWER. The TAG **reiterated** the importance of completing the spatial modelling analyses for Phase I. It will greatly assist in the design of Phase II (including choice of survey areas and stratification). Spatial modelling approaches also provide a better approach to recalculating abundance estimates for different geographical boundaries as new information on stock structure is obtained. This is discussed further under workplan (Items 7, 9.4 and Table 2).

Further discussion of the ability to detect trends and the use of spatial modelling in the light of analyses presented at the Workshop (WP10 and WP14) is given under Item 7.

It is envisaged that the DISTANCE sampling approach will form the major component of the next phase of IWC-POWER.

4.2.3 Individual identification (photo and genetic)

Although DISTANCE sampling approaches are standard for many species, for others, mark-recapture methods to obtain abundance estimates from individual identification data are an alternative or even preferable. It is important to note that whilst line transect abundance estimates represent a snapshot of animals in the survey area at a certain time, mark-recapture estimates represent an estimate of the number of animals using an area over time (depending on certain assumptions). Mark-recapture estimates are particularly suited to species where obtaining sufficient sample sizes is possible e.g. where large sampling effort is/has been possible e.g. humpback whales and eastern North Pacific blue whales (see Items 5.3 and 5.6) or small populations where densities are too low to obtain reliable abundance estimates with realistic levels of effort under the IWC-POWER programme (e.g. eastern North Pacific right whales – see Item 5.2). In most cases, the value of data collected by IWC-POWER has been and will continue to be to contribute samples/photos from offshore areas to existing individual identification catalogues; such collaborations will also form an important part of Phase II strategy. The possibility of focussed studies (e.g. targeted to North Pacific right or blue whales) to collect such data in some small areas in some years (or part years) in Phase II is considered under Item 7.

It is envisaged that biopsy sampling and photo-ID using the current methods will continue to be an important component of IWC-POWER.

4.2.4 Acoustics

Acoustic techniques have not been used to estimate abundance in the IWC-POWER programme to date and even in principle, of the large whales it has only been successfully used to estimate the abundance of sperm whales using towed arrays of hydrophones (e.g. Lewis *et al.*, 2019, in the Mediterranean Sea). With current resources, this is unlikely to form part of the IWC-POWER programme although the possibility will be kept under review.

However, acoustics (directional sonobuoys) have been used successfully in the programme to improve detection of right whales to obtain biopsy samples and photo-ID data to assist in mark-recapture estimation (e.g. on the 2017 cruise – a similar approach was used for blue whales under IWC-SOWER). Acoustic data also provide valuable information on relative occurrence of species and the TAG agreed that where feasible, acoustic work continues. A summary of the acoustic work from the 2023 cruise is given in Annex D.

It is envisaged that acoustics will continue to be an important component of IWC-POWER.

4.2.5 Telemetry

In 2021, a feasibility experiment (total cruise time spent just under 6 hours) to investigate the use of telemetry to elucidate the diving behaviour of two fin and two sei whales was undertaken with the objective of using such data to investigate availability bias in order to try to correct abundance estimates. This was undertaken voluntarily by Japan. The field experiment was successful and dive sequence data were obtained from 2 fin and 2 sei whales via satellite but the need for improvements was noted.

This year, the TAG received WP09 that summarised the results of the feasibility study of the satellite tagging to date. With respect to obtaining dive time data, over a total of three years, diving behaviour tags were deployed on 7 fin whales and 8 sei whales, and dive data was obtained from 5 fin and 7 sei whales, respectively.

The TAG welcomed this initiative (and see Item 4.3.3). The value of increased telemetry effort in Phase II for specific questions of the IWC-POWER programme is considered under the relevant agenda items below.

It is envisaged that telemetry work will form a component of the second phase of IWC-POWER.

4.3 Stock structure and movements

4.3.1 Population structure related genetic analyses from biopsy samples

The genetic component of the IWC-POWER cruise has proved to be extremely successful and has already made important to contributions to the work of the Scientific Committee (e.g. the RMP *Implementation Review* for Bryde's whales and the ongoing Comprehensive Assessment of sei whales). Details are provided by species along with information on when analyses are expected to be completed under Item 5. In general, to date analyses have focussed on mtDNA and microsatellites (14-17 loci). However, high-throughput sequencing approaches, including genome-wide SNP (single nucleotide polymorphisms) genotyping, are now being implemented for certain species (see Item 5) and produce data that can be more powerful than traditional approaches and do not require cross-laboratory calibration.

It is envisaged that biopsy sampling and genetic analyses will continue to be an important component of IWC-POWER.

4.3.2 Movements from individual identification (photo and genetic)

'Recaptures' of individually identified animals can not only be used to estimate abundance but also provide information on movements. The likelihood of recaptures clearly increases where data are shared amongst all researchers across the Pacific, ideally in the form of single catalogues. As noted under Item 4.2.3, the major contribution of the IWC-POWER programme has been and will be to contribute samples/photos from offshore areas to existing individual identification catalogues; such collaborations will also form an important part of the medium-term strategy.

It is envisaged that biopsy sampling and photo-ID to identify individuals will continue to be an important component of IWC-POWER.

4.3.3 Telemetry

Telemetry can provide valuable information on long-term movements of whales that can in turn provide valuable information on potential mixing of populations and location of breeding grounds. In 2023, deployment of tags for monitoring the horizontal movement of blue whales was attempted and tracking data for 30 days was obtained from one blue whale (WP09).

(WP 10 and see Item 4.2.5). The use of telemetry for long-term movements (in the next phase of the IWC-POWER programme is considered under Item 7.

4.4 Marine debris

The IWC-POWER cruises have collected information on marine debris since 2010, using a strategy to minimise any disruption of the primary aim of collecting data on cetaceans (i.e. collecting such data only for the first 15 minutes of each hour). The data from 2010-2016 have been analysed in light of previous comments by the Scientific Committee and the TAG. The manuscript is almost complete and the TAG looks forward to its publication in the near future.

It is envisaged that such studies be continued in the next phase of the programme.

4.5 Other (e.g. related to environment)

During the first phase of IWC-POWER it had been agreed that it was not practical to undertake the collection of any more oceanographic information from the vessel than that which could easily be obtained without the need to stop the vessel (primarily sea surface temperature). However, the TAG **agrees** on the importance of oceanographic data to the IWC-POWER programme (e.g. with respect to spatial modelling). It **agrees** that a

number of external data sources (e.g. satellites and ocean models) can provide information and that these should be explored recognising that care is needed to determine that it can be obtained at a suitable scale. Although it is a low priority and the actual feasibility of the installation needs to be examined, the possibility of collecting data by an echosounder to qualitatively understand the distribution of prey species of cetaceans should be considered along with the possibility of using new technology such as Sea Gliders (and see Item 7).

It is envisaged that collecting oceanographic and prey distribution data may form a component of IWC-POWER if practical considerations can be overcome

5. REVIEW OF RESULTS AND AVAILABLE INFORMATION BY SPECIES

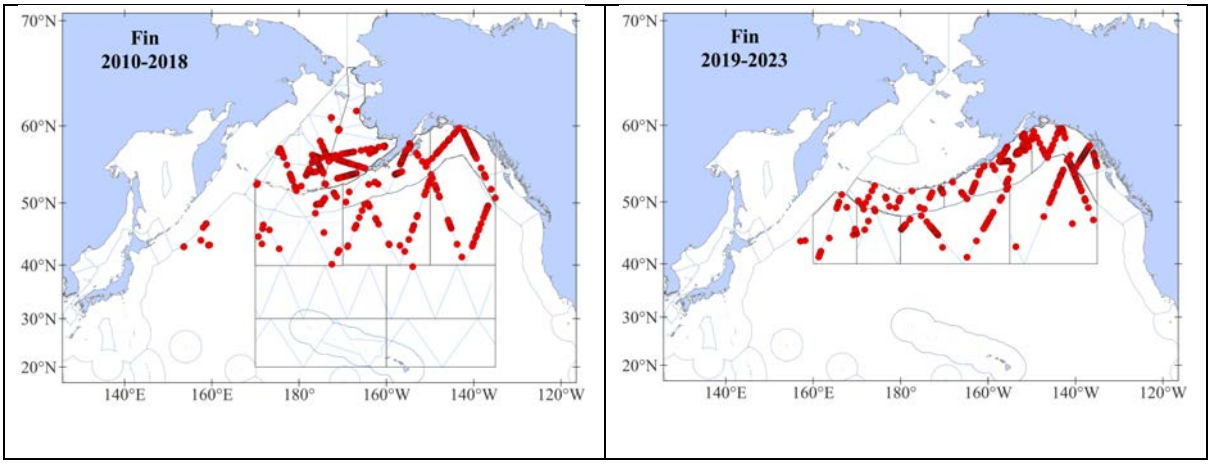
5.1 Fin whales (High priority)

5.1.1 Distribution and stock structure

Fig. 2 shows the distribution of sightings and biopsy samples for the cruises from 2010 to 2022. Fin whales are widely distributed throughout the surveyed areas north of 40N – this is broadly in accord with past summer catch data. The distribution of sightings suggest that fin whales are probably found to the west and east of the surveyed areas as they were in the past. The western waters are partly covered by Japanese national surveys (ref) but it is clear that for a full picture it will be necessary to obtain information from Russian waters. Unfortunately, proposed IWC-POWER cruises to Russian waters have not received permits by the Russian Federation (e.g. see discussion in SC69D) and this is unlikely to occur anytime soon given the present political situation. There is a suggestion that due to warmer waters as a result of climate change, fin whale distribution might extend further north into the northern Bering and Chukchi Seas. The 2024 cruise will extend to the north into part of the Chukchi Sea (see Fig.1).

The spatial modelling referred to under Item 5.1.2 will greatly assist in developing density maps and planning for the next phase of IWC-POWER (and see Items 7, 9.4 and Table 2).

The biopsy samples (n=154) are well distributed throughout the surveyed area. The Workshop was informed that the Southwest Fisheries Science Center (SWFSC) in La Jolla California is developing a SNP genotyping panel for use with fin whales; this panel will be used to genotype approximately 300 samples, including some from IWC-POWER surveys (IWC, 2020), to evaluate stock structure within the eastern North Pacific. The ICR is planning laboratory work for mtDNA control region sequencing and microsatellite DNA (16 loci) genotyping for a stock structure study that will incorporate IWC-POWER samples and samples from the western North Pacific from other sources (IWC, 2020). Genetic analyses on stock structure are ongoing and the completion of such analyses will greatly assist in the undertaking of any future Comprehensive Assessment of North Pacific fin whales. This should include comparisons with other populations, including the East China Sea.



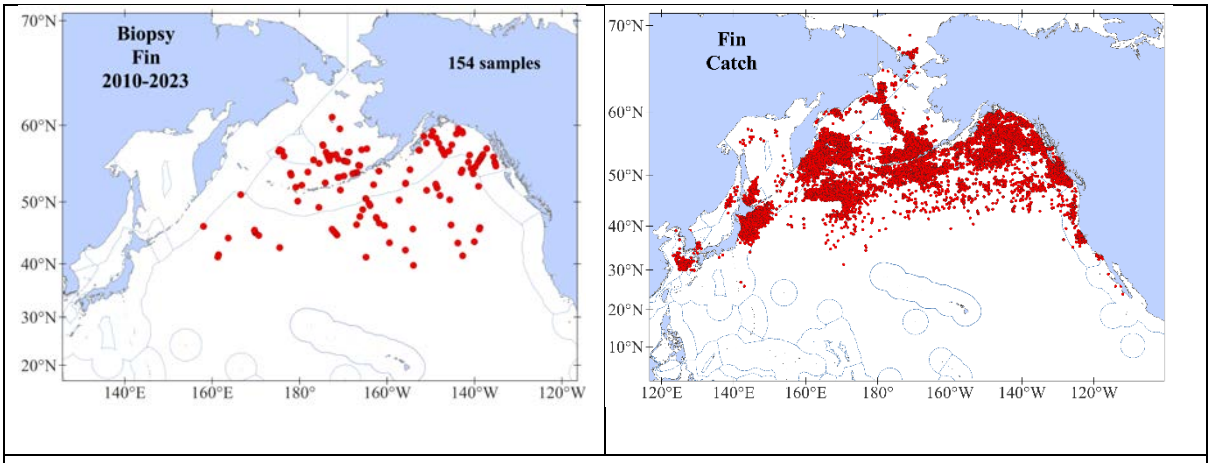


Fig. 2. Fin whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions (all months) from the IWC catch database version 7.1. Dotted blue lines show EEZs.

5.1.2 Abundance

The TAG has previously received *preliminary* design-based estimates of fin whale abundance up to 2018 (SC/69A/REP03). These were uncorrected for *g*(0) or additional variance.

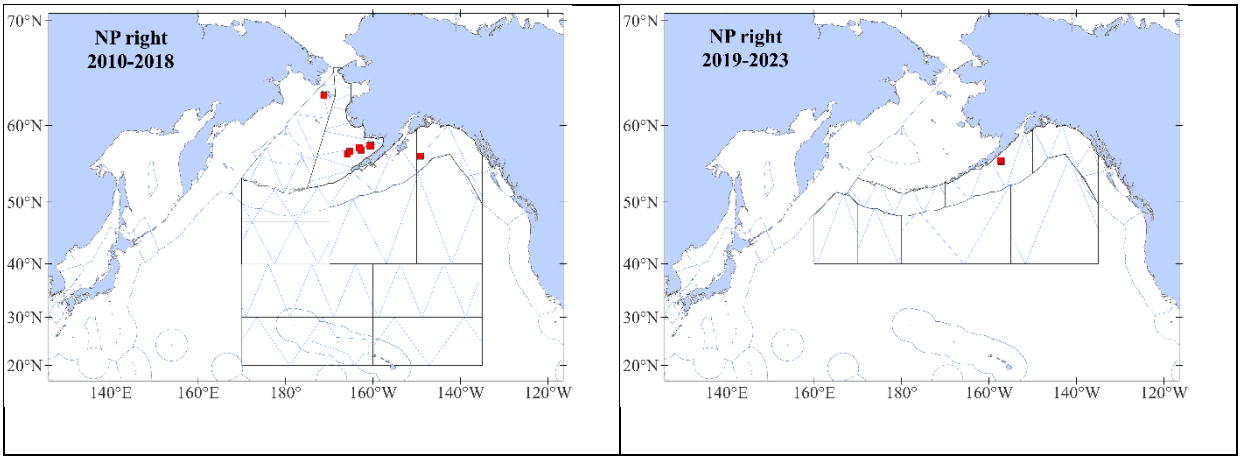
Analysis of the data to estimate g(0) is underway and additional variance will be investigated *inter alia* by comparing estimates from the early period (2010-12) with those for similar areas in the later period (i.e. 2019422), recognising that the survey periods for the later cruises were a little later (August-September compared to July-August). The TAG **recommends** that corrected fin whale design-based and model-based estimates for the whole period are developed as a high priority (see Item 9.4 and Table 2).

5.1.3 Outstanding issues relative to new survey

Previous recommendations for work to evaluate the use of photo-ID data for this species should be carried out to determine its value for Phase 2 (and see Item 7).

5.2 North Pacific Right whales (High priority)

5.2.1 Distribution and stock structure



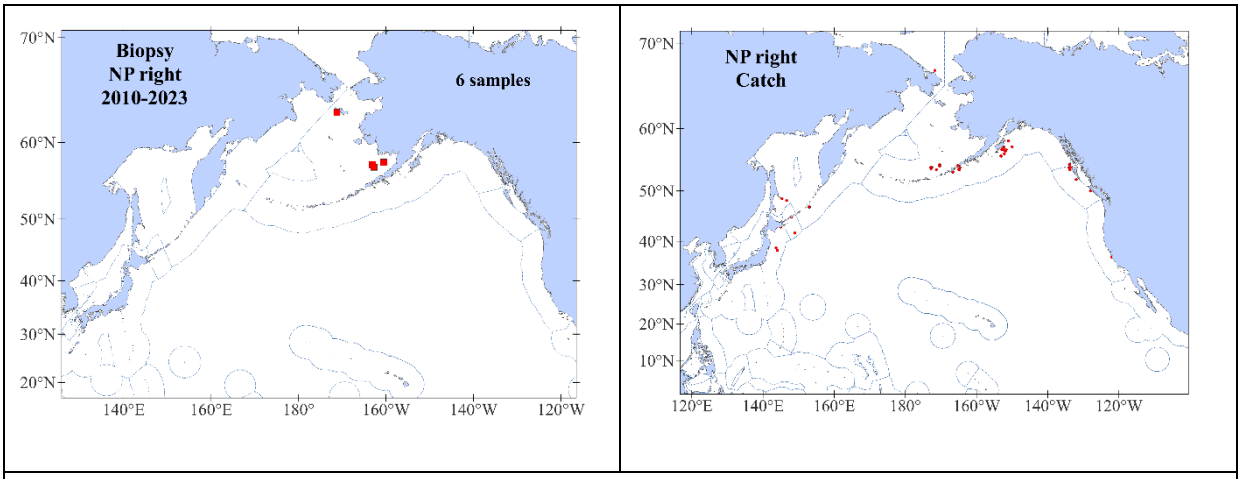


Fig. 3. North Pacific right whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). There are no modern catches in the IWC catch database version 7.1. Dotted blue lines show EEZs.

Few sightings (Fig. 3) of this species have been made even with the assistance of directional hydrophones to assist in detections. The sighting in the northern Bering Sea was unusual. Distribution is clearly limited in the eastern North Pacific within the IWC-POWER area.

High priority was given to obtaining biopsy samples (*n*=6) from any animals seen and these IWC-POWER samples have been incorporated into a larger scale study of North Pacific right whales. Pastene *et al.* (2022) summarised and analysed genetic data generated from these samples in combination with all other available genetic data of this species, in the context of a collaborative genetic study between the SWFSC and the ICR focused on stock structure. Microsatellite genotyping was completed for 19 samples collected in the western North Pacific; comparison of mtDNA control region sequences included 30 samples each for the eastern and western North Pacific.

The mtDNA results, suggesting population structuring, were consistent with the pattern of catch and sighting data showing higher densities on either side of the North Pacific, but little in between as suggested by Clapham et al. (2004). These findings support the hypothesis of different populations occurring in the eastern and western sides of the North Pacific. An alternative, although less likely interpretation of these results is that there is a single interbreeding population in the North Pacific that exhibits mtDNA structuring as a result of matrilineally driven seasonal site fidelity. The generation of comparable nuclear data (e.g., SNP genotypes) from currently available and future samples collected from both the eastern and western North Pacific would help discriminate between these hypotheses.

The TAG **welcomed** news that a paper outlining all sightings of North Pacific right whales in the eastern North Pacific since 2006, including those from IWC-POWER is expected soon (WP06).

5.2.2 Abundance

There are insufficient sightings data to develop a reliable DISTANCE sampling based abundance estimate from the IWC-POWER cruises and the clearly low abundance makes it unlikely that such an approach will be successful in the future. The contribution of IWC-POWER to obtaining abundance estimates lies in providing individual identification data to existing catalogues to allow for mark-recapture abundance estimates to be derived. The use of acoustics to assist in the detection of North Pacific right whales to increase sample size for individual identification is recommended. The TAG **reiterated** the importance of developing updated mark-recapture estimates (including IWC-POWER data) as soon as possible, in accordance with the Committee's recommendation last year (IWC, 2024 Recommendation SC2341).

5.2.3 Outstanding issues relative to new survey

The major issue for the future is to determine strategies that will facilitate increased sample sizes to enable mark-recapture estimates to be developed in conjunction with other projects in the North Pacific (see Item 7 and Table 1).

5.3 Blue whales (High priority)

5.3.1 Distribution and stock structure

Blue whales have been observed throughout the IWC-POWER study area, primarily north of 40N as far as the Aleutian chain. The recent surveys including in transit data (and data from other sources including Japanese national surveys) show that that the western edge of the study area does not represent the western boundary for blue whales. The total number of IWC-POWER blue whale biopsy samples is 51 (including samples taken during transit). Even though the sample size is small, the samples are widely distributed throughout the IWC-POWER research area, north of 40°N (Fig. 4).

The Workshop was informed that SWFSC generated mitogenome sequences for the IWC-POWER samples up to 2017 (n=9) for use in a project evaluating the global subspecies taxonomy of blue whales (IWC, 2020). The Workshop was also notified that whole genome sequencing of blue whale samples, including some of those collected on IWC-POWER surveys, is being conducted by Oregon State University and the NOAA Pacific Marine Environmental Laboratory. With respect to stock structure and contributing towards a future Comprehensive Assessment of North Pacific blue whales, the Workshop was informed that ICR is planning mtDNA and microsatellite laboratory work for a study that will also incorporate samples from the western North Pacific (IWC, 2020).

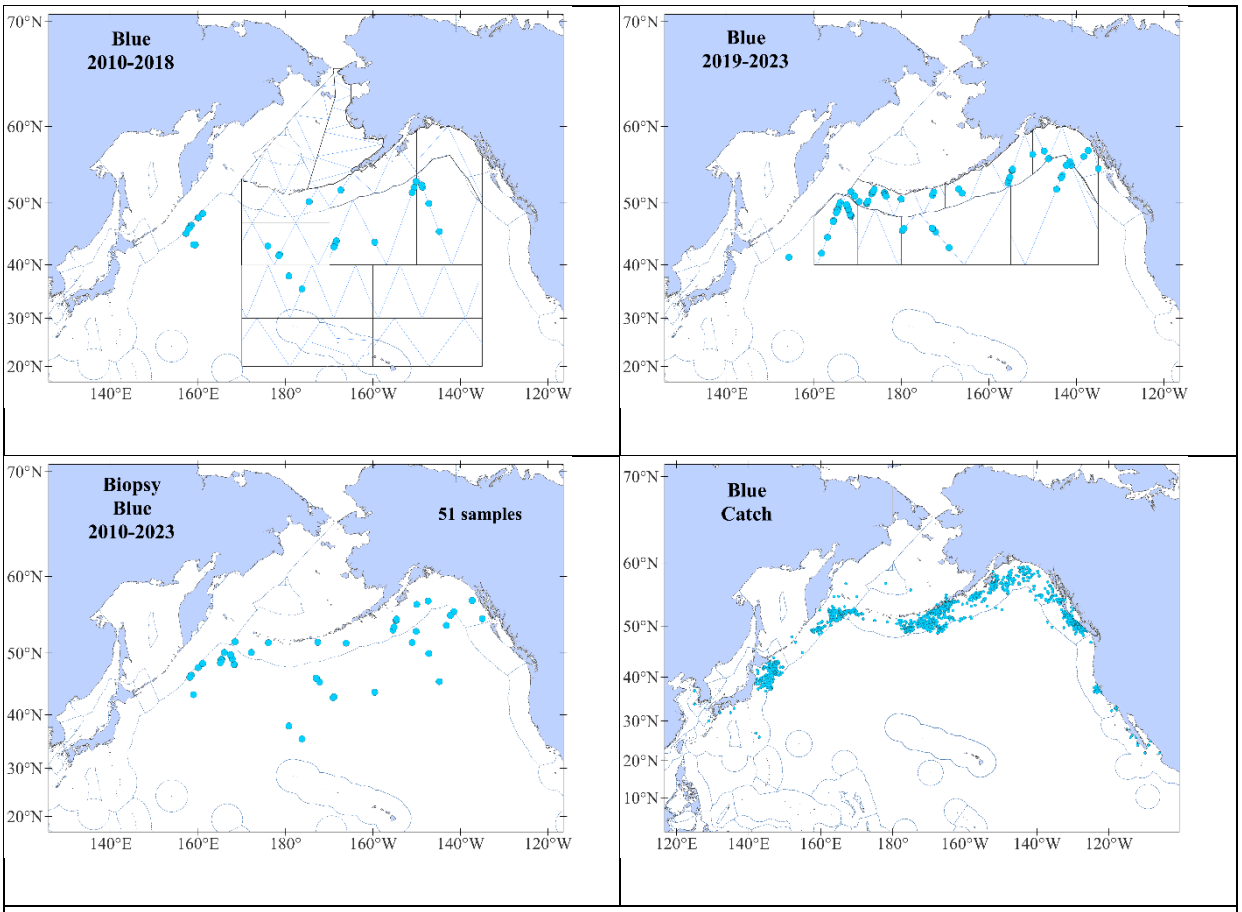


Fig. 4. Blue whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions (all months) from the IWC catch database version 7.1. Dotted blue lines show EEZs.

5.3.2 Abundance

To date, only the data for the 2010-2012 surveys have been analysed. The sample size was small (15 primary sightings) and the *preliminary* design-based estimate (uncorrected for $g(0)$ or additional variance) of around 1,100 with a CV of 0.38) is provided *only* to provide context in terms of the development of the next phase of IWC-POWER and should **not** be cited or considered an agreed estimate. The TAG **reiterates** that an analysis of all of the blue whale data after completion of the 2023 survey should be undertaken promptly (see Workplan).

Consideration should be given to obtaining mark-recapture abundance estimates from photo-ID efforts throughout the North Pacific by collaboration with other research groups, ideally resulting in a single catalogue (and see Item 7 and Table 1).

5.3.3 Outstanding issues relative to new survey

The IWC-POWER sightings and biopsy data have provided the first systematic recent information on this species in these waters related to abundance and stock structure. Photo-ID efforts are promising. Full analyses of the available information (IWC-POWER and other sources) on these topics should be undertaken in the next 2-3 years to enable an appropriate strategy and priority for Phase 2 (see Item 7 and Table 1).

5.4 Humpback whales (Medium priority)

5.4.1 Distribution and stock structure

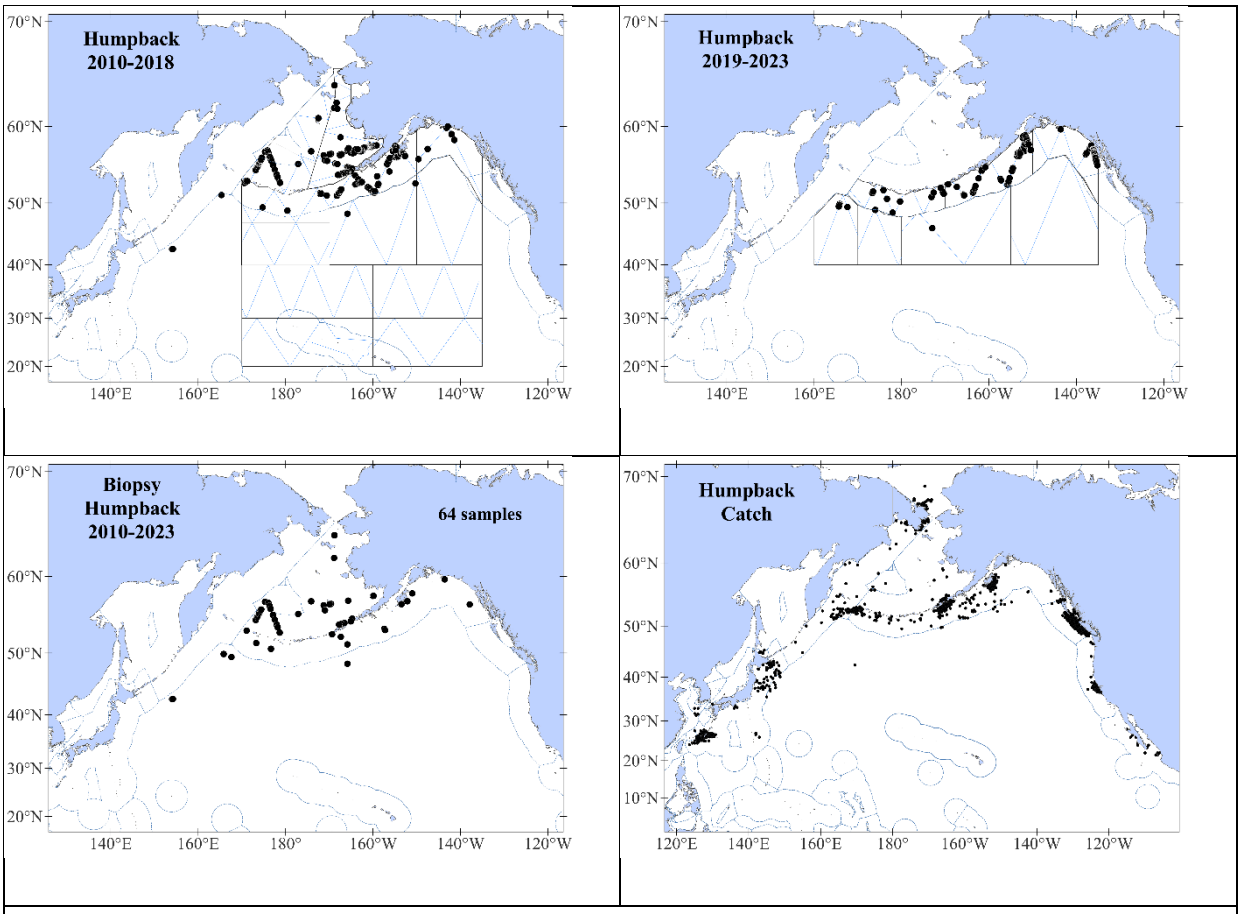


Fig. 5. Humpback whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions (all months) from the IWC catch database version 7.1. Dotted blue lines show EEZs.

Humpback whales were widely distributed throughout the surveyed areas north of around 50N (Fig. 5).

The total number of IWC-POWER humpback whale biopsy samples is 64 and they are widely distributed longitudinally in the IWC-POWER research area, north of 50°N (Fig. 9). These samples have not been analysed yet. Photo-id data have been shared with the North Pacific catalogue and are being used as part of the Comprehensive Assessment.

5.4.2 Abundance

As for other species, *preliminary* abundance estimates have been provided in the past where attention was drawn to differences in detection functions between the Gulf of Alaska and the Bering Sea. It was agreed that this must be investigated further, along with consideration of $g(0)$ and additional variance before final estimates are presented to the Scientific Committee. The TAG **stressed** the importance of completing this work as soon as possible (see Item 9.4 and Table 2). It was noted that whilst IWC-POWER line-transect estimates can provide information to the ongoing Comprehensive Assessment of North Pacific humpback whales, mark-recapture

estimates are the primary source of the abundance estimates used (IWC-POWER photographs make an important contribution to that effort).

5.5 Bryde's whales (eastern North Pacific, Medium priority)

5.5.1 Distribution and stock structure

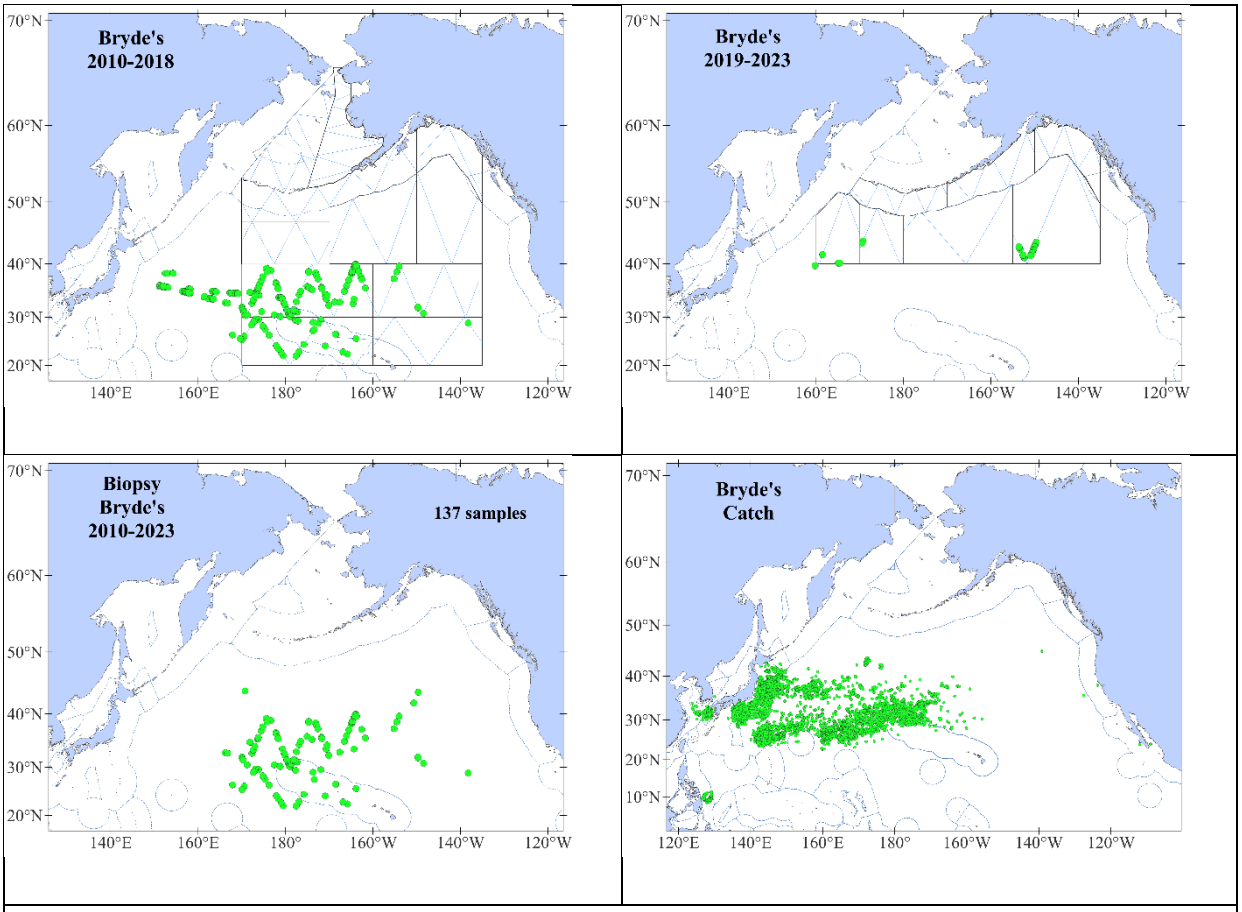


Fig. 6. Bryde's whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions from the IWC catch database version 7.1. Dotted blue lines show EEZs.

Bryde's whales were, as previously thought, primarily found south of around 40N. Within the surveyed areas they were most abundant between around170E and 160W but the former clearly did not represent a distribution boundary as witnessed by sightings by Japanese surveys.7

The total number of IWC-POWER Bryde's whale biopsy samples is 139 and they are widely distributed in the IWC-POWER research area, south of 40°N (Fig. 6). The IWC-POWER samples have played a major role in the Implementation Review of this species in the western North Pacific related to stock structure, in conjunction with samples from Japanese whaling. In particular they were the predominant samples to the east of 180E. The results of that work have been extensively discussed within the Scientific Committee in the context of *Implementation Reviews.*

5.5.2 Abundance

The Scientific Committee has used abundance estimates from the IWC-POWER surveys as an important part of the *Implementation Review* process.

5.5.3 Outstanding issues relative to new survey

For the future, primary biopsy sampling effort should be spent in areas east of 150°W in order to further examine the two stocks proposed for the western and central North Pacific. There is also a need to investigate the relationship between Bryde's whale stocks in the North Pacific with a genetically differentiated stock in the Gulf of California and the East China Sea.

From the analytical point of view, additional analyses based on kinship could be valuable to assist the interpretation of the current results of the heterogeneity test and Bayesian analyses. The development and use of additional genetic markers e.g. SNPs, is recommended to further examine the available genetic samples.

Given the other high priority species and the distribution of Bryde's whales, the TAG **agrees** that a targeted survey or surveys should be considered later in the programme (e.g. after 2029) in light of further analysis of the existing data. Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) and diving behaviour (to investigate availability bias in line-transect estimates).

Previous recommendations for work to evaluate the use of photo-ID data for this species should be carried out to determine its value for Phase 2 (and see Item 7).

5.6 Sei whales (Medium priority)

5.6.1 Distribution and stock structure

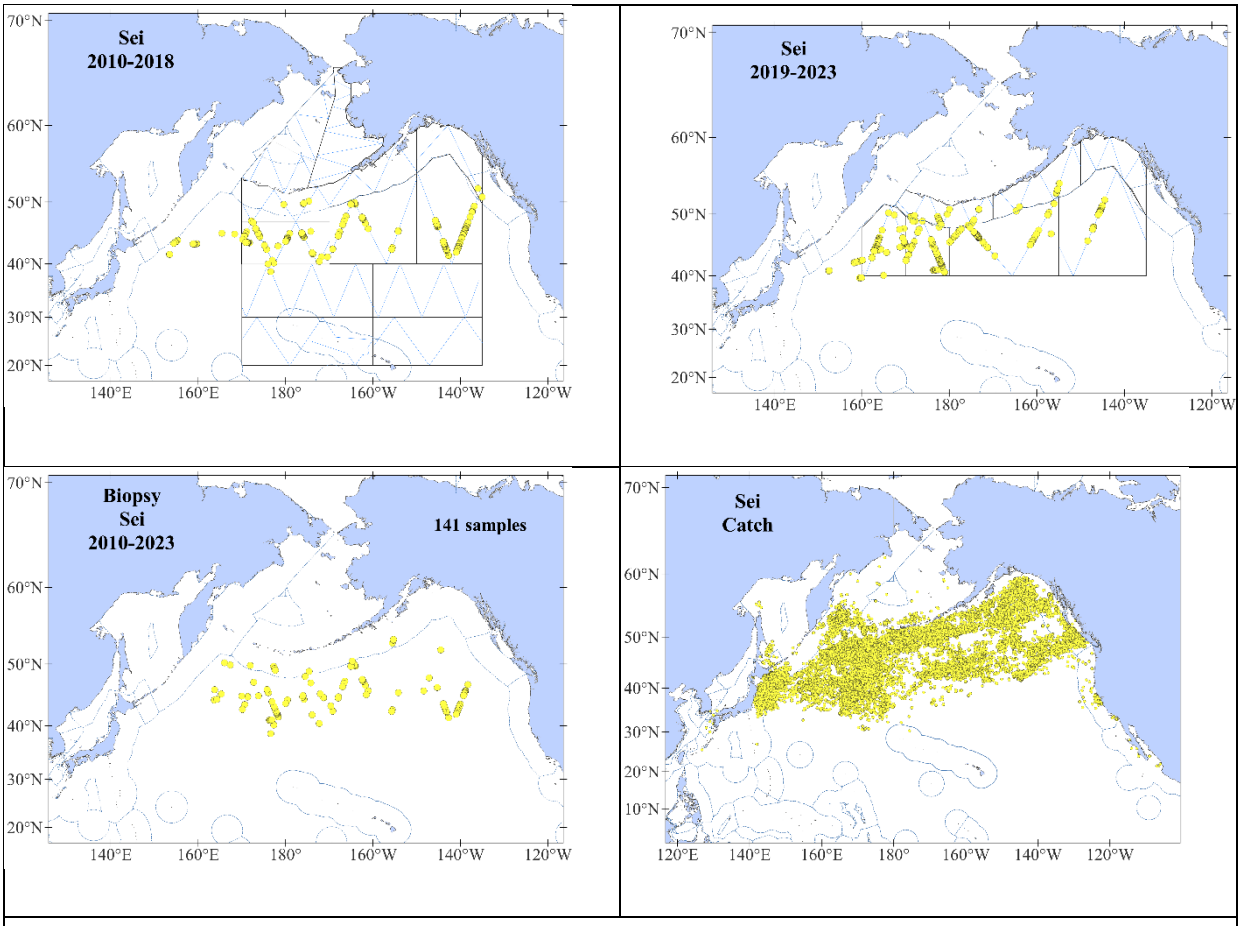


Fig. 7. Sei whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions from the IWC catch database version 7.1. Dotted blue lines show EEZs.

Sei whales were found throughout the surveyed areas between around 50N and 60N, as expected.

The total number of IWC-POWER sei whale biopsy samples is 141 and they are widely distributed in the IWC-POWER research area, north of 40°N (Fig. 13). These samples are playing a major role in the ongoing Comprehensive Assessment of sei whales (along with samples from Japanese national cruises). The Committee has decided to proceed with two hypotheses on stock structure, one that consider a single stock in the North Pacific and the other that considers five stocks. The first is based on the interpretation of genetic and non-genetic analyses while the second is based on an interpretation of mark-recapture data. Based on the results of the genetic analyses, the Committee has agreed that at least the pelagic region of the North Pacific comprises a single stock of sei whales.

The IWC-POWER biopsy samples were important for the analyses described above because they covered the eastern North Pacific, an area where the number of historical samples was small and dated. The additional samples from IWC-POWER allowed an increase in the number of samples (increase in the power of the analysis) and allowed the testing for temporal genetic differences in the eastern North Pacific (e.g. Kanda et al., 2015). The use of techniques such as SNPs may assist where there are few samples such as the coastal areas (and see Item 5.6.3 below).

5.6.2 Abundance

The Scientific Committee is using preliminary abundance estimates from the IWC-POWER surveys as part of the Comprehensive Assessment of sei whales. The need to finalise design-based and model-based estimates as soon as possible is **reiterated** (see Item 9.4 and Table 2).

5.6.3 Outstanding issues relative to new survey

Results of the Comprehensive Assessment will help focus the Phase II IWC-POWER strategy and priorities for this species.

The TAG recognised that whilst the stock structure hypotheses with 5 stocks would benefit from samples from the coastal areas (e.g. the Aleutians) and from where there were considerable catches in the past. However, the IWC-POWER surveys have seen few animals there and thus the possibility of obtaining such biopsy samples appears low. The value of targeted telemetry seems more practical for Phase 2.

5.6.4 Other

Previous recommendations for work to evaluate the use of photo-ID data for this species should be carried out to determine its value for Phase 2 (and see Item 9.4).

5.7 Sperm whales (Medium priority)

5.7.1 Distribution and stock structure

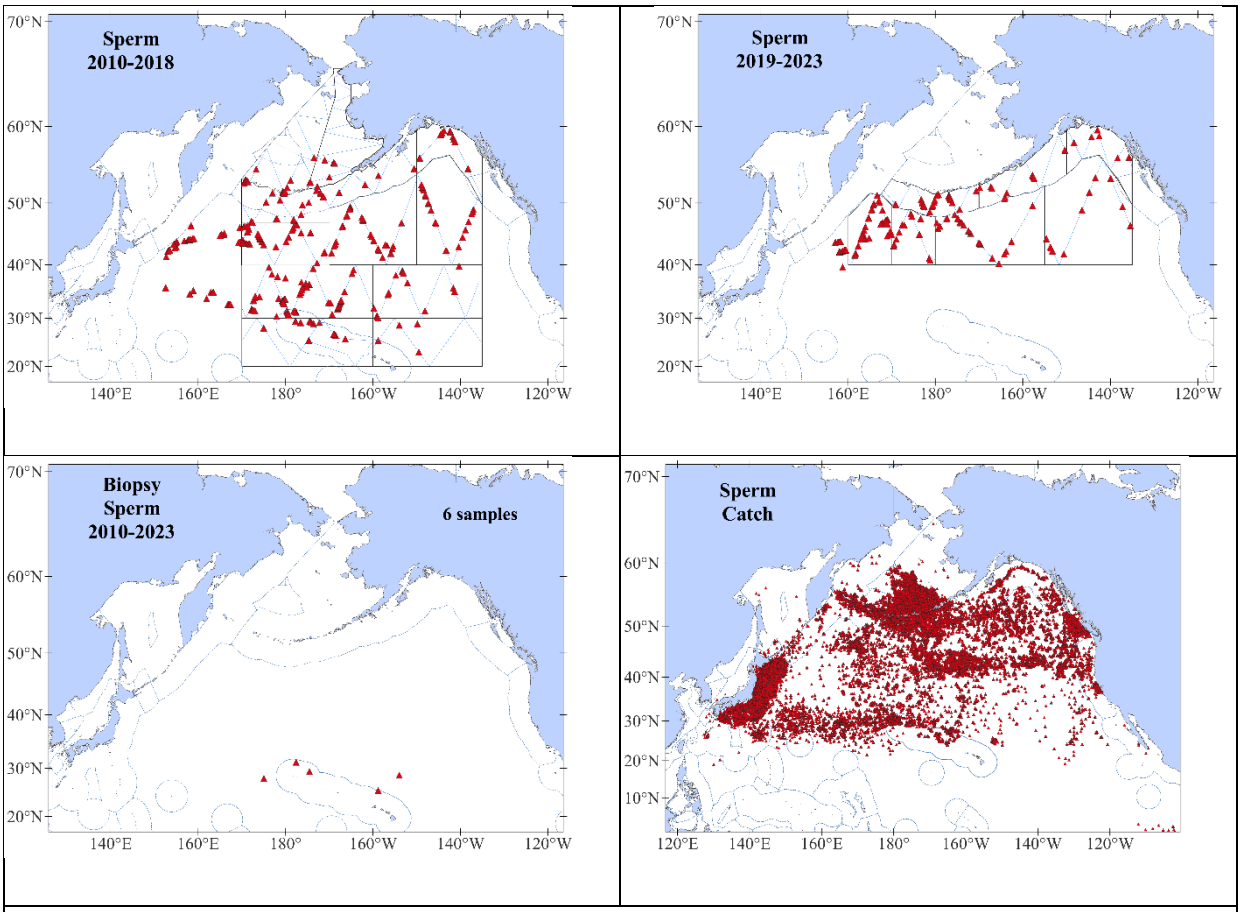


Fig. 8. Sperm whales: the top two figures show sightings whilst the bottom left figure shows positions of biopsy samples (includes transit). The bottom right shows historic catch positions from the IWC catch database version 7.1. Dotted blue lines show EEZs.

Sperm whales are seen commonly throughout the area apart from the Bering Sea.

Collection of biopsy samples is a low priority and the total number of IWC-POWER sperm whale biopsy samples is 6, and these were obtained south of 30°N (Fig. 7). These samples have not been analysed yet and would only be of value in conjunction with other studies.

5.7.2 Abundance

Obtaining abundance estimates of sperm whales from visual surveys is problematic due *inter alia* their extremely long dive times, as the Scientific Committee has previously noted. However, if certain assumptions are made, they can provide a suitable index of abundance. Uncorrected abundance estimates provide minimum estimates and initial line transect abundance estimates from IWC-POWER (still being finalised) suggest tens of thousands of sperm whales in the North Pacific.

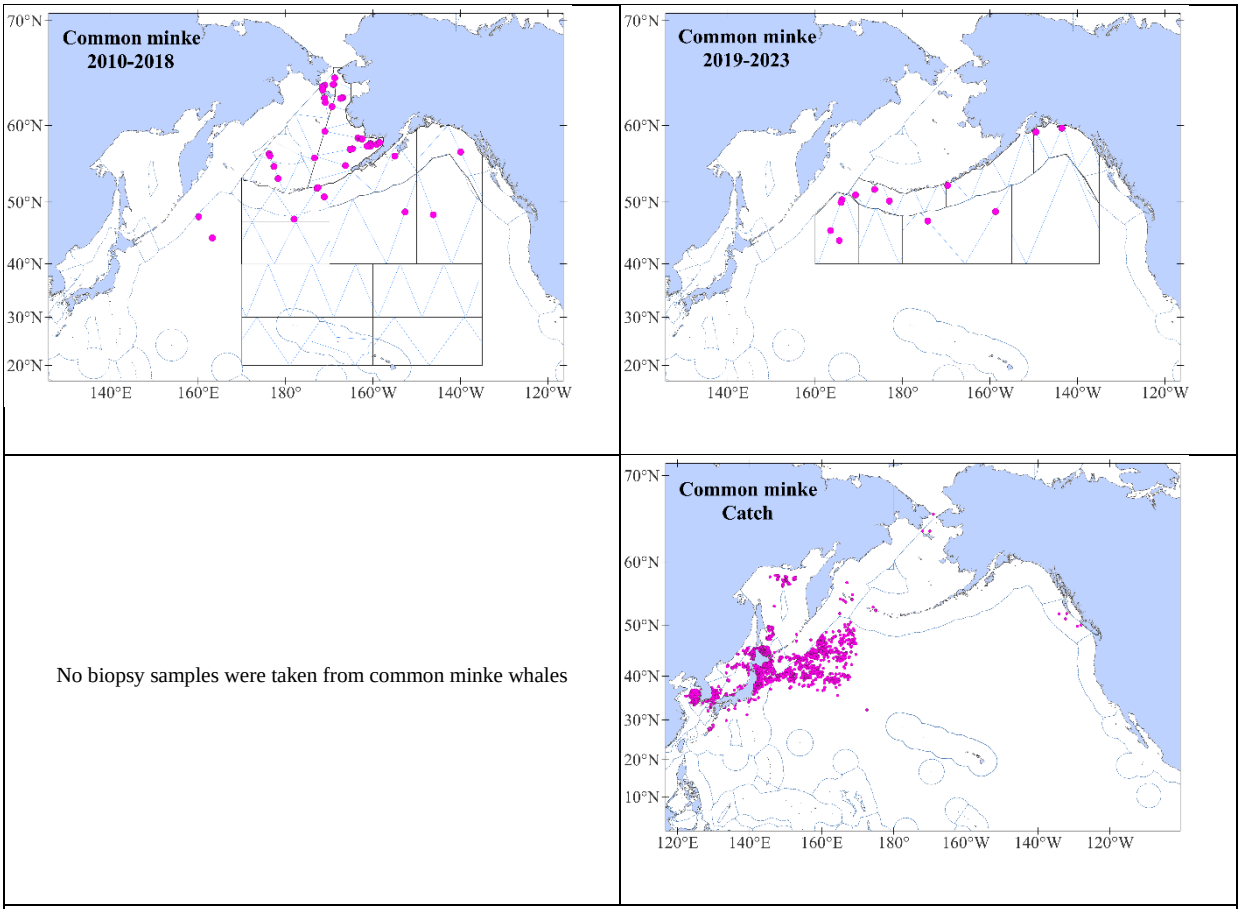
5.7.3 Outstanding issues relative to new survey

The TAG has previously noted that the possibility of using towed acoustic arrays to try to obtain abundance estimates in some targeted years could be considered under IWC-POWER in Phase II, depending on availability of equipment, suitable vessels and practicality in light of other priorities. Future surveys along the present lines will contribute to indices of relative abundance/minimum estimates.

5.8 Common minke whales (eastern North Pacific, Low priority)

5.8.1 Distribution and stock structure

The TAG noted that although common minke whales were reported, the sightings conditions for the surveys are not optimal (deliberately so) for common minke whales that are a low priority for the IWC-POWER programme. Thus, the sightings data do not provide a reliable indication of overall distribution. They are not a target for biopsy sampling.



No biopsy samples were taken from common minke whales

Fig. 9. Common minke whales: the top two figures show sightings (includes transit). The bottom right shows historic catch positions from the IWC catch database version 7.1. Dotted blue lines show EEZs.

5.8.2 Abundance

Although abundance estimates can be calculated from the IWC-POWER data, the TAG **agreed** that they are not reliable given the sub-optimal sightings conditions.

5.8.3 Outstanding issues relative to new survey

The TAG **agreed** that common minke whales remain a low priority for the IWC-POWER programme. However, if the Okhotsk Sea is able to be covered at some time in the future for high priority species (e.g. right whales) then it would be appropriate to consider modifying present 'acceptable' conditions to allow the estimation of abundance for this species. It would also be valuable to obtain biopsy samples for this important area for any future in-depth assessment.

5.9 Other species

The TAG **agreed** that it was important to examine the distribution and abundance of the other cetacean species recorded during IWC-POWER in light of previous recommendations at a future meeting. Once available, these estimates will inform future IWC-POWER discussions (see Item 7).

6. REVIEW OF OTHER (I.E. NON IWC-POWER) PAST AND ONGOING SURVEY ACTIVITIES AND AVAILABILITY OF DATA

The TAG noted the enhanced value of collaborative analyses with surveys and other efforts occurring outside the IWC-POWER cruises. This is already the case for a number of Scientific Committee initiatives such as *Implementation Reviews* and Comprehensive Assessments as noted above. It was **agreed** that as soon as possible and certainly prior to the 2025 TAG meeting, the Steering Group should develop a list of relevant activities (e.g. oceanography, fish surveys) for discussion (see Item 9.4).

7. INITIAL PLAN FOR ACHIEVING MEDIUM TO LONG-TERM OBJECTIVES AND PRIORITIES BASED UPON LESSONS LEARNED UNDER ITEMS 4 AND 5

7.1 Update, if necessary, of objectives (e.g. stock structure, abundance, trends) and priority species

Last year, the TAG spent considerable time updating the medium-long term objectives and these were accepted by the Scientific Committee (IWC, 2024 – recommendation no. SC23127). The TAG reviewed Table 1 again this year and made some minor clarifications.

Table 1

Medium-term priorities based upon results from Phase 1 for IWC-POWER thus far (* refers to likelihood of obtaining an abundance estimate at least in some areas ** refers to likelihood of obtaining biopsy and/or photo-ID data from encountered schools).

NB Consideration of the effect of possible distribution changes due to climate change will be a general priority for most species (e.g. by extending the surveyed areas to the north). See Item 5 for more details and recommendations by species. The rationale/comments below represent only a brief summary

Initial priority/feasibility	Rationale/comments
Blue whale (High) High direct*, high opportunistic**	• Depletion level in the west is unknown but may be high given past catches. The population in the east is estimated to have recovered to 62-99% of its unexploited level Monahan *et al*., 2015) with abundance at about 2-3,000 based on mark-recapture estimates from long-term studies south and east of the IWC-POWER survey area. • Initial line transect abundance estimates from IWC-POWER (still being finalised) suggest around one thousand animals in the surveyed area. • Results of genetic analyses of existing samples (43 IWC-POWER samples in conjunction samples from other programmes e.g. samples collected by Japan in the west) will inform on sub-species taxonomy, population structure and management units. Consideration of other data sources (e.g. 'songs') to complement genetic studies (e.g. Sremba et al. 2019) should be undertaken including analysis of existing sonobuoy data collected under IWC-POWER. • Given the size of the line-transect abundance estimate, the probability of obtaining mark-recapture estimates using data from the northern waters and in co-operation with the existing data from the USA and Japan is high if focussed cruises (or parts of cruises) are undertaken in specific areas in the east and west to collect photo-ID and biopsy samples. Opportunistic studies on other cruises should continue. • Continued collaboration with existing photo-id work e.g. in the US and by Japanese national programmes is important and the possibility of a single catalogue should be investigated as a priority. • Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) and diving behaviour (to investigate availability bias in line-transect estimates, although the primary method for obtaining abundance estimates is likely to be mark-recapture)

Fin whale (High) High direct*, high opportunistic**	• Depletion level was thought to be high based upon the catch history at the start of IWC-POWER. As a result of IWC-POWER (and other work), North Pacific fin whales are now a potential Comprehensive Assessment candidate and this will enable the present depletion level to be established. • Initial line transect abundance estimates from IWC-POWER (still being finalised) suggest tens of thousands of fin whales in the North Pacific. • Results of genetic analyses will make an important contribution to understanding stock structure and management units in the North Pacific. These are expected within two years. This will help to develop future survey strategy as well as a Comprehensive Assessment. Incorporation of existing data from the USA, Japan and Korea is important. • Co-ordination with national programmes in Japan, Korea (in the context of comparisons with the East China Sea population) and USA should continue and be strengthened. Work in Russian Federation waters provided appropriate permits can be obtained is important • Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) and diving behaviour (to investigate availability bias in line-transect estimates)
Right whale (High) High direct*, high opportunistic**	• Depletion level: highly depleted based on catch history, especially in the east (data from US studies and IWC-POWER). • Absolute numbers in the east are well below 100 and the valuable data collected thus far from IWC-POWER should be incorporated and focussed studies in the east should continue. New abundance estimates from the east including IWC-POWER data are expected soon. • Numbers in the west are considerably higher and whilst obtaining abundance from line-transect surveys is feasible even without operating in Russian waters. However, estimates would be greatly improved if at some future time, permits were obtained for Russian waters including those close to the coast. Focussed studies to obtain increased numbers of photo-ID and biopsy samples in international waters in the west (e.g. international waters to the south and east of Kamchatka) should be undertaken. Collaboration with work by Japan and the USA is important and the possibility of a single catalogue should be investigated as a priority. Nuclear genetic analyses are needed to determine whether interbreeding between the east and west occurs. • Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) provided that safeguards are in place (c.f. the telemetry programme for western gray whales off Sakhalin)
Sei whale (Medium) High direct*, high opportunistic**	• Depletion level: this is being investigated as part of the ongoing IWC Comprehensive Assessment to which IWC-POWER data (abundance, distribution, genetics) have proved invaluable • Initial abundance estimates from IWC-POWER (still being finalised) and Japan are in the tens of thousands • Analysis of genetic and other data have thus far led to two stock structure hypotheses – a single stock or a five stock-hypotheses with a single pelagic stock in the areas covered by IWC-POWER and Japan and five postulated coastal stocks. • Results of the Comprehensive Assessment will help focus future IWC-POWER medium-term strategy and priority for this species. • Whilst obtaining biopsy samples from the postulated coastal stocks will be very valuable, a targeted strategy to obtain these is infeasible given the very low densities in such areas covered by IWC-POWER thus far. • Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) and diving behaviour (to investigate availability bias in line-transect estimates)
Humpback whale (Medium) High direct*, high opportunistic**	• Good information already available from SPLASH and national programmes suggests overall high abundance (genetic and photo-ID mark-recapture) hence medium priority • IWC-POWER has contributed valuable data/samples to existing genetic and photo-ID databases and this should continue • Ongoing Comprehensive Assessment will assess status and potential depletion of populations in the North Pacific • Abundance estimates from IWC-POWER (still being finalised) sightings data will provide interesting 'snapshot' estimates to compare with the primary mark-recapture estimates by population/feeding aggregations (to which IWC-POWER photographs contribute). • The results of the Comprehensive Assessment will assist in developing the Phase II strategy and priority for this species by population within IWC-POWER • Telemetry studies will be considered for diving behaviour (to investigate availability bias in line-transect estimates)
Sperm whale (Medium) Medium direct* and low opportunistic**	• Depletion level: unknown but possibly high given catch history • Lack of good information on population structure and status although good distributional data from IWC-POWER • Obtaining abundance estimates from visual surveys can be problematic due to long dive times and other issues but if certain assumptions are made they can provide a suitable index of abundance. Uncorrected abundance estimates provide minimum estimates and initial line transect abundance estimates from IWC-POWER (still being finalised) suggest tens of

	thousands of sperm whales in the North Pacific • Obtaining biopsy samples and photo-ID has proved to be difficult under IWC-POWER and priority is low given this combined with the high population size • Possibility of using towed acoustic arrays in some years in the longer term could be considered depending on availability of equipment, suitable vessels. and practicality in light of other priorities
Bryde's whale (Medium) High direct*, high opportunistic**	• Suggest low priority for at least the first six or so years of next phase of POWER because: o The most recent *Implementation Review* shows good population status and apparently low level of threats o Removing from target species allows a great reduction in size of priority research area to north of 40ºN • A targeted survey or surveys is to be considered from 2029 in light of analysis of the existing data • Telemetry studies will be considered for long-term movements (relevant to distribution, movements within the surveyed area and identification of breeding areas) and diving behaviour (to investigate availability bias in line-transect estimates)
Common minke whale (Low) Suggest only opportunistic	• Depletion level (probably low east/central based upon catch history) and in west dealt with by national programmes. • From the outset of IWC-POWER it was agreed that common minke whales were a low priority for the programme thereby allowing acceptable sighting conditions to be set at higher sea states than optimal for minke whales to increase effort for the larger whale species. • However, if Okhotsk Sea is able to be covered for high priority species (e.g. right whales) then would provide valuable information incl. biopsy samples • If permission granted by Russian Federation, then consider modifying present 'acceptable' conditions as at the present high range they are unsuitable for estimating abundance for this species
Gray whale (Low) Low direct*, high opportunistic**	• There are ASW hunts but the primary data sources to evaluate those are from other visual, genetic and photo-ID programmes (e.g. USA, Mexico, Sakhalin Island) – hence medium priority. These are evaluated under the AWMP and a series of rangewide workshops. • Main IWC-POWER contribution is in obtaining biopsy/photo-ID in areas outside those programmes for comparison to contribute to existing information on population structure. An important area for this would be in the feeding grounds especially the western Chukchi Sea which would require permission to operate in Russian waters. • Sharing of data with the other programmes primarily responsible for providing information on the assessment of gray whales should continue
Bowhead whale (Very low) Low direct*, high opportunistic**	• There are ASW hunts but the primary data sources to evaluate those are from the USA national programme. This is evaluated under the AWMP. • The IWC-POWER cruises in northern waters may encounter bowhead whales. If they do, they should record the sightings data but no effort needs to be expended on photo-ID or biopsy sampling as stock structure and abundance is well-known. An important area for this would be in the western Chukchi Sea but this would require permission to operate in Russian waters.

7.2 In light of objectives and previous experience, consideration of whether new survey areas should be considered and if so where (e.g. areas further north including Beaufort and Chukchi Seas, areas further south and east including breeding areas in winter) taking into account other likely research programmes (and see Item 6)

Finalising appropriate regions and strata requires an integration of the results from Phase I, scientific priorities, resources and the geopolitical situation. Last year, the TAG had noted that from a scientific perspective there is merit in covering the Okhotsk Sea (right and common minke whales), the Beaufort and Chukchi Seas (especially fin, humpback and gray whales) and in investigating potential changes in density and distribution of various species in the light of changes in climate. It notes that the geopolitical situation precludes work in Russian waters in the foreseeable future.

Given the available resources, the ability to determine whether there are trends in abundance over time and if so to what extent is a major objective of IWC-POWER and some power analyses have been discussed previously with suggestions for updates. Such analyses are a critical component of the design of Phase II. It is already known that increased sample size/effort improves the accuracy and precision of abundance estimates making trend detection more likely – thus if Phase II continues with only one vessel, then a detailed power analysis examining factors affecting the ability to detect trends is essential for planning. This will also inform decisions on whether or not to expand the research area, and strata within the existing research area.

Kitakado introduced WP14, which presented some results from an updated statistical power analysis aiming to examine the ability to detect trends (declines or increases) in whale abundance using two abundance estimates from the IWC-POWER surveys. The first estimate was assumed to be derived from the 2010-2018 series and the

second from a hypothetical future survey. The analysis indicated that with no additional variance, changes (especially negative changes) in abundance can be detected with a relatively high probability if the sampling coefficient of variation (CV) of the abundance estimates is reasonably small. This probability increases when the number of samples in the second survey is increased, but the degree of increase in statistical power is not as significant. However, it is evident that the presence of additional variance (additional CV = 0.15) reduces the statistical power to some extent, and the reduction becomes substantial when assuming a higher additional variance (additional CV = 0.3). Furthermore, it is apparent that the smaller the true change (effect size), the more challenging it is to detect with statistical confidence. These findings underscore the need for further study of survey effort and survey design in future IWC-POWER surveys.

The TAG welcomed this work, noting that there are many factors that influence the ability to detect trends in abundance using two (or more) abundance estimates. Some of these (the effects of the CV of the abundance estimates, additional variance, the true change, and the direction of the true change) were examined in WP14 but others, such as natural productivity and response to climate change may also affect our ability to detect trends. Another method used by the IWC SC to detect trends is the use of population dynamics models, as in the case of the RMP or AWMP or Kitakado's approach (ref) for Antarctic minke whales.

Elsewhere, the importance of spatial modelling approaches to estimate abundance from the existing IWC-POWER data has been noted (e.g. see Item 5 and 9.4). The TAG also noted the value of using spatial modelling approaches to investigate trends, especially when distribution shifts are also occurring. In light of this suggestion, the TAG **recommends** that the simulations proposed to assess the merits/demerits of abundance estimation by spatial modelling (e.g. as also recommended by the EM sub-committee) be expanded to examine whether spatial modelling can reduce the extent of additional variance in the total abundance estimate and its CV in the presence of inter-annual variation of whale distribution, and thus improve the statistical power of detecting a trend. The results of such a simulation study will be of great value to inform survey design and required survey effort in Phase II.

This is discussed further in the Workplan (see Item 9.4 and Table 2).

7.3 In light of objectives and previous experience, consideration of whether experimental cruises are needed to test new technology or methodological approaches

The TAG noted the feasibility study on telemetry that had already been undertaken on a voluntary basis by Japan during the IWC-POWER cruises (e.g. see Item 4). It noted that for a number of species, Table 2 refers to telemetry studies that could assist both with correcting abundance estimates and addressing issues of stock structure and movements. Whilst not suggesting that experimental cruises are necessary, it notes that, where specific questions are identified for Phase II, emphasis on telemetry might be greater for some cruises should resources be available. It notes that any such planning should take into account the best practice guidelines adopted by the Scientific Committee and others (Andrews *et al.*, JCRM, Vol. 20).

Given the importance of obtaining data for spatial modelling, consideration should also be given in the future for collaborative studies using Sea Gliders, provided sufficient resources are available.

7.4 Field methods by objectives and taking into account feasibility and priority species in light of analytical approaches

The TAG referred to the discussions above related to the updated priorities. It noted that the primary research methods used to date (distance sampling, biopsy sampling and photoidentification were likely to remain the primary methods for the next phase) along with, depending on logistics and Scientific Committee priorities, consideration of newer techniques such as telemetry, drones or targeted surveys using acoustics.

8. WORKPLAN WITH THE OBJECTIVE OF FINALISING THE PLANNING FOR PHASE II PROGRAMME FROM 2026-2030

The TAG **stresses** that several important analyses remain to be completed to finalise the plans for Phase II. For a variety of reasons progress has been slower than was expected at the last meeting. Considerable time was spent on finding strategies to assist in the completion of these as soon as possible and some by SC69B. The immediate workplan is discussed under Item 9.4 and summarised in Table 2.

The TAG also drew attention to two suggestions for work on the high priority species given in Table 1 for particular consideration in Phase II that are less dependent on receiving the results of the priority analyses given in Table 2. These included:

(1) Blue whales: the probability of obtaining mark-recapture estimates using data from the northern waters and in co-operation with the existing data from the USA and Japan is high if focussed cruises (or parts of cruises) are undertaken in specific areas in the east and west to collect photo-ID and biopsy samples.
(2) North Pacific Right whales: numbers in the west are considerably higher and whilst obtaining abundance from line-transect surveys is feasible this would require permits to operate in Russian waters including those close to the coast which is unlikely to be granted in the near future. Focussed studies to obtain photo-ID and biopsy samples in international waters in the west (e.g. international waters to the south and east of Kamchatka) should be undertaken. Collaboration with work by Japan and the USA is important and the possibility of a single catalogue should be investigated as a priority.

The TAG **reiterates** that finalising the appropriate study areas, strata and methods requires an integration of the results from Phase I, scientific priorities and likely resources (see Item 9.4).

In this regard, it agrees that it will be valuable if SC sub-groups that address North Pacific issues are asked to indicate any additional priorities they might have that IWC-POWER could assist with in addition to those identified in this report and the programme thus far.

Given the importance of obtaining at least abundance estimates promptly from IWC-POWER cruises, the TAG **agrees** that the 2025 TAG develops procedures (with cost estimates if necessary) to ensure smooth and prompt data analyses for Phase II.

9. OTHER GENERAL MATTERS

9.1 Participation of other range states in IWC-POWER and Co-ordination with other research activities

The Committee has long supported the IW-POWER programme. For little IWC funds, thanks to the generosity of the Government of Japan, systematic surveys and data collection has taken place in areas that have not been covered for decades, if ever. Many of those areas had been subject to intense whaling in the past. The TAG noted that Japan remains a co-owner of the IWC-POWER data and refers to the data access protocol for IWC-POWER and IWC-SOWER and IDCR data (SC Handbook).

The first phase of IWC-POWER has set a valuable baseline for meeting the long-term objective of understanding stock structure and estimating trends in several populations and determining where conservation priorities might lie. The ability to detect trends in a reasonable timeframe is largely dependent on the effort that is available. The TAG **reiterates** previous recommendations that the Scientific Committee:

> (1) **encourages** all Member Governments and Range States to support IWC-POWER either financially or in-kind – in particular this might be achieved by co-ordinating existing research field work with that of IWC-POWER; and
>
> (2) **encourages** the IWC to increase efforts to advertise its willingness to share IWC-POWER data for integrated analyses (e.g. biopsy and photo-ID data, data on marine debris), especially where analyses of such data alone will provide only limited information.

9.3. Permits and related matters

The TAG **reiterates** the importance of Governments and scientists to continue to work proactively to facilitate the obtaining of necessary research permits associated with the work of IWC-POWER including permission to operate in national waters and the CITES process for biopsy samples.

The TAG discussed the need for consistent wording for the acknowledgement of the use of IWC-POWER data in manuscripts. The Agreed wording is provided in Annex D.

9.4 Immediate workplan

The TAG appreciated the heavy workload of many of those undertaking analyses of the IWC-POWER data. However it is now essential that this work is completed as soon as practical and a number of approaches were considered, in particular it was noted that some of the work can be undertaken by a graduate student under suitable supervision. The TAG was pleased to be informed that it was likely that such a student would begin work with Kitakado in April this year.

Table 2 below summarises the immediate workplan. The TAG **requests** that short progress reports on the analytical items are submitted to the TAG on 17 March 2024 with either completed products or detailed progress being reported to SC69B.

It was noted that the factsheet highlighting the work of the IWC-POWER programme would benefit from being developed in conjunction with the Communication Initiative of the Scientific Committee. This is a

project which aims to inform and advise the Commission in a succinct and non-technical manner. A key part of this initiative is the development of factsheets summarising the work the Scientific Committee using a common template to help Commissioners and other stakeholders better understand its work. Staniland will work with the Comms Initiative to draft a factsheet related to IWC-POWER that can be presented to the TAG for its consideration.

Item	Activity	Responsible persons (lead in bold type)	Time
Data			
(1)	Complete validation of IWC-POWER sightings and effort data for the period up to the 2023 cruise and submit GPS and shape files	**Matsuoka** and Hughes	Ongoing
(2)	Complete importation and classification of 2023 IWC-POWER photographs into the IWC photographic database	Taylor, **Matsuoka** and Staniland	Ongoing
Analyses			
(1)	Complete and publish analyses of angle/distance experiments	**Kitakado** and Matsuoka	Almost complete
(2)	Develop final abundance estimates (design-based) for humpback, blue, fin, sei and Bryde's whales following the advice provided in IWC (2020a), incorporating estimates from (4)	**Matsuoka, Kitakado,** and scientists from TUMSAT/ICR	Finalise as soon as possible and certainly prior to TAG in 2025
(3)	Develop final abundance estimates (model-based) for humpback, blue, fin, sei and Bryde's whales following the advice provided in IWC (2020a) and later (incorporating estimates from (4)	**Kitakado, Matsuoka** and scientists from TUMSAT/ICR	Finalise as soon as possible and certainly prior to TAG in 2025
(4)	Provide final estimates of $g(0)$ for those species it is considered possible (including fin, sei and humpback) following the advice provided in IWC (2020a) and later.	**Miyashita** and scientists from TUMSAT/ICR	Finalise as soon as possible and certainly prior to TAG in 2025
(5)	Develop abundance estimates for small cetacean species (killer etc.)	**Matsuoka, Kitakado** and others	Ongoing. Updated draft expected at 2025 TAG
(6)	Simulation work investigating spatial modelling approaches following advice provided in IWC (2020a) and later.	**Kitakado** and Palka	First stage of the study to be submitted to TAG in 2025
(7)	Finalise work on power analyses taking into account comments at this meeting	**Kitakado** and Palka	Finalise as soon as possible and certainly prior to TAG in 2025
Future			
(1)	Develop a Factsheet covering IWC-POWER Phase I, focussing on achievements and the development of Phase II	**Staniland** and Steering Group	After SC69B

10. ADOPTION OF THE REPORT

The Chair thanked the participants for their hard work and the Government of Japan for its support for the meeting and for the cruise. The participants thanked the Chair for his hard work and leadership. The participants expressed their gratitude for the Japanese Government's voluntary co-operation in deploying two US NOAA drifting buoys to collect beaked whale sounds for the first time.

REFERENCES

[To come]

Annex A
List of Participants

Robert Brownell	Southwest Fisheries Science Center, U.S.A.
Jessica Crance	Alaskan Fisheries Science Center, U.S.A.
Greg Donovan	IP
Takeru Iida	Fisheries Agency of Japan
Hidehiro Kato	Institute of Cetacean Research, Japan
Taiki Katsumata	Institute of Cetacean Research, Japan
Yume Kawai	Fisheries Agency of Japan
Toshihide Kitakado (co-Chair)	Tokyo University of Marine Science and Technology, Japan
Aimée Lang	Southwest Fisheries Science Center, U.S.A.
Koji Matsuoka (co-Chair)	Institute of Cetacean Research, Japan
Tomio Miyashita	Institute of Cetacean Research, Japan
Hiroto Murase	Tokyo University of Marine Science and Technology, Japan
Debra Palka	Northeast Fisheries Science Center, U.S.A.
Iain Staniland	Head of Science, IWC
Saemi Baba	Interpreter 1
Yoko Yamakage	Interpreter 2
Hiroko Yasokawa	Interpreter 3
Reiko Nagata	Tokyo University of Marine Science and Technology, Japan

Annex B
Agenda

1. INTRODUCTORY ITEMS
1.1 Opening remarks and welcoming address
1.2 Election of Chair and rapporteurs
1.3 Adoption of Agenda
1.4 Review of available documents

2. REVIEW OF PLANNING DISCUSSION AT PREVIOUS SC (SC/69A/REP/03A&03B)[1]
2.1 Short term options (incl. information gaps)
2.2 Medium and long-term (incl. information gaps)

3. OBJECTIVES OF THIS WORKSHOP

4. UPDATE AND REVIEW OF GENERAL SURVEY AND ANALYTICAL APPROACHES (2010-2023)[2]
4.1 Primary and secondary objectives of surveys related to field and analytical methods used taking into account available resources
4.2 Distribution and abundance
- 4.2.1 Choice of survey areas and cruise track design
- 4.2.2 Survey methods for Distance sampling (including survey modes, distance and angle experiments) and analytical approaches (design-based and spatial approaches)
- 4.2.3 Individual identification (photo and genetic)
- 4.2.4 Acoustics

4.3 Stock structure and movements
- 4.3.1 Population structure related genetic analyses from biopsy samples
- 4.3.2 Movements from individual identification (photo and genetic)
- 4.3.3 Telemetry

4.4 Other including marine debris

5. UPDATE AND REVIEW OF RESULTS AND AVAILABLE INFORMATION BY SPECIES
5.1 Fin whales
- 5.1.1 Distribution and stock structure
- 5.1.2 Abundance
- 5.1.3 Outstanding issues relative to new survey(s)
- 5.1.4 Other

5.2 North Pacific Right whales
- 5.2.1 Distribution and stock structure
- 5.2.2 Abundance * (Sighting, Acoustic, Photo-ID, Genetic etc.)
- 5.2.3 Outstanding issues relative to new survey(s)
- 5.2.4 Other

5.3 Humpback whales
- 5.3.1 Distribution and stock structure
- 5.3.2 Abundance
- 5.3.3 Outstanding issues relative to new survey(s)
- 5.3.4 Other

5.4 Common minke whales
- 5.4.1 Distribution and stock structure
- 5.4.2 Abundance
- 5.4.3 Outstanding issues relative to new survey(s)
- 5.4.4 Other

[1] including implications of the present political situation and work in waters of the Russian Federation

[2] Species specific considerations appear under Item 5

5.5 North Pacific Right whales
- 5.5.1 Distribution and stock structure
- 5.5.2 Abundance * (Sighting, Acoustic, Photo-ID, Genetic etc.)
- 5.5.3 Outstanding issues relative to new survey(s)
- 5.5.4 Other

5.6 Humpback whales
- 5.6.1 Distribution and stock structure
- 5.6.2 Abundance
- 5.6.3 Outstanding issues relative to new survey(s)
- 5.6.4 Other

5.7 Common minke whales
- 5.7.1 Distribution and stock structure
- 5.7.2 Abundance
- 5.7.3 Outstanding issues relative to new survey(s)
- 5.7.4 Other

5.8 Bryde's whales
- 5.8.1 Distribution and stock structure
- 5.8.2 Abundance
- 5.8.3 Outstanding issues relative to new survey(s)
- 5.8.4 Other

5.9 Blue whales
- 5.9.1 Distribution and stock structure
- 5.9.2 Abundance*(Photo-ID etc.)
- 5.9.3 Outstanding issues relative to new survey(s)
- 5.9.4 Other

5.10 Sei whales
- 5.10.1 Distribution and stock structure
- 5.10.2 Abundance
- 5.10.3 Outstanding issues relative to new survey(s)
- 5.10.4 Other

5.11 Sperm whales
- 5.11.1 Distribution and stock structure
- 5.11.2 Abundance
- 5.11.3 Outstanding issues relative to new survey(s)
- 5.11.4 Other

5.12 Other

6. REVIEW OF NON IWC-POWER PAST AND ONGOING SURVEY ACTIVITIES (INCLUDING AVAILABILITY OF DATA) IN THE CONTEXT OF ASSISTING WITH THE IWC-POWER PROGRAMME

7. INITIAL PLAN FOR ACHIEVING MEDIUM TO LONG-TERM OBJECTIVES AND PRIORITIES BASED UPON LESSONS LEARNED UNDER ITEMS 4 AND 5

7.1 Update if necessary of objectives (e.g. stock structure, abundance, trends) and priority species

7.2 In light of objectives and previous experience, consideration of whether new survey areas should be considered and if so where (e.g. areas further north including Chukchi Sea) taking into account other likely research programmes (and see Item 6)

7.3 In light of objectives and previous experience, consideration of whether experimental cruises are needed to test new technology or methodological approaches

7.4 Field methods by objectives and taking into account feasibility and priority species in light of analytical approaches

7.4.1 Changes in abundance and distribution

7.4.1.1 Research area choice and cruise design

7.4.1.2 Survey methods and analytical approaches including consideration of new technology (e.g. dive time correction via telemetry and or drones, portable echosounder, new environmental data to assist in spatial modelling)

7.4.2 Population structure and movements

7.4.2.1. Field protocols and priority species (biopsy, photo-id, acoustics, other)

7.4.3 Other

8. PROPOSAL FOR NEXT THREE-FIVE SEASONS WORK

9. OTHER GENERAL MATTERS

9.1 Participation of other range states in IWC-POWER

9.2 Co-ordination with other research activities

9.4 Data Ownership, photo credit and Data Archive

9.5 Publication

9.6 Other

10. ADOPTION OF REPORT

Annex C
DOCUMENTS

WP

1. Report of Technical Advisory Workshop on Planning for the Medium-Long Term IWC-POWER Programme (SC/69A/REP/03/A)
2. Report of the IWC-POWER Planning Meeting (SC/69A/REP/03/B)
3. Report of the 2024 IWC-POWER Planning Meeting (SC/69B/REP/01/A)
4. Extraction of Report of the Scientific Committee (SC/69A)
5. Cruise Report of the 2023 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER)
6. Update on North Pacific right whale manuscript using POWER sighting data
7. Results of the drifting hydrophone experiment in the 2023 IWC-POWER
8. Overview of the whale sighting surveys conducted on IWC-POWER North Pacific cruises from 2010 to 2023
9. Results of the feasibility experiment of satellite tagging for fin, sei and blue whales on POWER, 2021-2023
10. Review of distance and angle experiments conducted in the IWC-POWER surveys
11. Abundance estimates of blue whale on design base analyses using 2010-2023 data
12. Results of a feasibility study of seabird sighting survey in the 2023 IWC-POWER surveys
13. Biomass estimates on design-based analyses using 2010-2018 IWC-POWER sighting data

Annex D

Draft for IWC-POWER (minimum) credits (NB similar wording can be used for IDCR and SOWER data)

USE OF DATA IN A MANUSCRIPT

Include in Acknowledgements for use of High Seas only data:

The authors acknowledge the permission to use data [do we want to specify the type(s)?] *from the IWC-POWER cruises* (https://iwc.int/scientific-research/sower/power) *granted by the International Whaling Commission, the Government of Japan and the Institute of Cetacean Research. The data were collected under permit no. XXXXX issued by the Government of Japan.*

If data taken within US waters are used the following wording must also be added:

['Some' or *'All'] of the data were collected under activities conducted pursuant to US NMFS ESA/MMPA Permit No. U2023-003 [or presumably more if multiple cruises].*

PHOTO CREDITS WITHIN MANUSCRIPT (NB – THE ACKNOWLEDGEMENTS WILL ALSO CONTAIN THE WORDING ABOVE)

If taken on the High Seas

Photo, copyright IWC and the Government of Japan, taken by [name] during the 20XX IWC-POWER cruise. The photo was collected under permit no. XXXXX issued by the Government of Japan.

If taken under a US permit,

The following must be added to the text above:

The photo was taken under activities conducted pursuant to US NMFS ESA/MMPA Permit No. [U20XX-00X]