Summary of Responses to a Length-Measurement and Age-Reading Questionnaire on Southern Hemisphere Minke Whales

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Abstract

A summary is provided of responses from experienced researchers to a questionnaire on minke whale aging and length measuring. Such a questionnaire was identified as a high priority for inter-sessional work at last year's IWC SC meeting, and was prepared by the e-mail intersessional group on VPA analysis related to Southern Hemisphere minke whales. Although the sample size was small, the responses confirm that there are still unresolved issues in the age reading of earplugs from Southern Hemisphere minke whales. The two most significant issues based on the questionnaire are: (1) the assessment of the readability of individual earplugs, and (2) undercounting of bands in older animals as the result of tight packing of growth layers. The consequence of non-migration on the formation of growth layers is also a potentially a source of bias in age estimates. Resolution of these issues remains a high priority for the completion of the minke whale catch-at-age analyses. Their resolution will most likely require further collaborative and comparative earplug readings and analyses among readers with different assessments of the extent to which both non-readability and tight packing occur.

Introduction

Comparisons of length-at-age data in the commercial and JARPA Antarctic minke whale catches suggest apparent inconsistency in these data (Punt and Polacheck 2005, Polacheck and Punt 2006). Aging and/or length measurement errors were considered in Polacheck and Punt (2006) as possible hypotheses contributing to this apparent inconsistency. They noted that there were unresolved questions with respect to the age and length data - some of which stem back to the review of age-reading methodology and age estimates for Southern Hemisphere minke whales conducted by the IWC Scientific Committee in 1984 (IWC, 1984). The 2006 IWC Scientific Committee meeting noted that the catch-at-age data are the fundamental input into the population modelling of southern hemisphere minke whale, and the Working Group on Population Modelling (IWC 2007) identified the following tasks as being of high priority:

(1) Develop appropriate error models for the catch-at-age data to be used in the population modelling to take into account potential errors and biases in the aging and length data and how these may have been changed overtime;
(2) Examine the data from the 1984 ageing workshop to provide insights for the development of error models for the catch-at-age data - particularly with respect to potential biases arising from unreadability of ear plugs being related to age;
(3) Develop a set of questions with respect to minke whale aging that could be distributed to those who have had experience in this area to provide a better understanding of the problems involved and potential errors in the catch-at-age data.

(4) Checking the commercial catch data for possible coding errors and updating these data if necessary.

Subsequently, the intersessional e-mail working group on VPA analysis related to Southern Hemisphere minke whales prepared and distributed a questionnaire in response to task (3). The current document was prepared by the chair of the inter-sessional working and provides a summary of the responses received.

The Questionnaire

The intersessional working group developed and agreed the set of questions listed in Appendix 1 to be included in the questionnaire. The chair of the working group (Polacheck), in consultation with the group, distributed the questionnaire along with a letter of explanation about the purpose of the exercise. Six responses were received representing 12 researchers (one response was a collective one, collating answers from seven individuals). Table 1 list the relevant experience of the respondents. It should be noted that the working group had difficulties identifying a large number of individuals with relevant experience, and only four individual among the respondents (including the group of seven) had experience ageing minke whales. No one with direct experience with length measurements in the Soviet catch was able to be identified. The working group would welcome suggestions for additional researchers to contact to increase the sample size if this issue is to be pursued further.

Length Measurement Issues

Two of the survey respondents had experience with or directly observed the measurement of minke whales during Japanese commercial whaling operations (both of these were in the 1970's). One respondent reported that he encountered no problems with the measurement of minke whales because of their relatively small size. However, he did note that inspectors and company staff measured the body lengths during commercial whaling, while scientists conducted the measurements during JARPA. He further considered that it would be better to use the material from JARPA to construct length-age keys, although he had no reason to believe there were any substantive differences in the methods used. The other respondent noted that failure to lay the measuring tape flat on the deck to avoid contamination with oil and blood was common. This produced some over-estimation of length, depending on how tightly the tape was held. He further suggested that the extent of over-estimation would likely be related to the size of the whale.

The one combined response from seven researchers with direct experience in JARPA sampling reported no problems with respect to ensuring that the length measurements were accurate. These respondents also reported that one technician who had been involved in both commercial and JARPA sampling had mentioned that he observed no serious differences in the measuring methods between the two types of operation.

Ear Plug Sampling Issues

All respondents who had experience with the extraction of minke whale ear plugs (two from commercial whaling and seven during JARPA) indicated that breakage and damage was a problem. Those individuals that did not have direct experience with minke whales, but had done ear plug extraction on other larger species reported that breakage and damage was also a problem. However, among those with experience with minke whales, there was not consensus on the extent and seriousness of the problem. During commercial whaling and JAPRA, it was intended that all ear plugs,

including fragments (when breakage occurred), should be collected. Earplugs were not collected were when they: (1) could not be found, (2) were too soft, or (3) very badly damaged (e.g. as a result of the harpoon damage to the earplg). It appears that comments on potential damage/breakage were not consistently reported in the data recorded for each individual during the commercial whaling operations. During JARPA, the status of all earplugs with respect to damage is recorded and photographs of the earplug are taken at the time of collection.

There was not consensus on whether it was possible to determine whether the entire earplug had been in fact extracted or if damage to the non-glove tip had occurred at the time of collection. The reading process involves a determination of whether loss of layers had occurred (either at the tip or as the result of fragmentation).

While some respondents indicated that there may have been situations where the potential existed for the mis-matching of earplugs with the associated biological data, all respondents that had field experience with earplug collection considered that this was unlikely to be a significant problem or source of error in the age data.

Age Reading Error Issues

Readability of Ear Plugs

All of the respondents that had experience in reading earplugs identified conditions under which collected earplugs would be unreadable or would provide an unreliable estimate of an animal's age. However, there was a large divergence of opinion about of the frequency with which this occurs. There appear to be three basic conditions which may cause earplugs to be unreadable or questionable as a basis for estimating age:

(1) the earplug is incomplete;
(2) the pattern of band layering is unrecognizable or extremely irregular; and
(3) the pattern of banding is regular but the patterning of layering is faint or obscured by flaws.

The problem of incomplete earplugs was reported to be primarily associated in minke whales with broken tips resulting in lost bands. Some respondents considered that this was associated primarily with smaller/younger animals. When this was identified to have occurred, all readers agreed that the earplug could at best provide a minimum estimate of age.

Two of the respondents reported that most collected earplugs from minke whales were in fact readable with broken tips being the primary reason for those cases in which it was not possible to obtain age estimates. Another respondent was unable to provide any quantitative assessment, and another reported that in his experience only ~50% of the minke whale earplugs collected were in fact readable. Damage or breakage was only responsible for about 13% of the earplugs being unreadable. Lack of pattern or highly irregular patterns were responsible for another 12% being considered impossible to be read and another 24% were considered to be unreliable because the pattern of layering was faint or obscured by "flaws". This respondent considered that flaws in the earplug was the most common cause of difficulties in reading, and recalled that such flaws were areas of a plug where the pattern of layering disappeared over a section.

Age Associated Effects

Three of the respondents noted for minke whales that smaller/younger animals were more likely to have readability problems and for which it was impossible to obtain an age estimate. However, it was not clear to what extent this was primarily due to earplugs from smaller/younger animals being more fragile and thus liable to breakage or be uncollectible, or because the bands are less clear for younger/smaller animals, with the bands becoming clearer with age. The extent to which these issues are size or age based and could hence lead to biases in the age-length relationship or age-length keys is also not clear.

One respondent reported that old animals have ear plugs with very packed growth layers at the base, making it hard to be sure that all have been counted. This respondent noted that the problem of tight banding occurs in fin whales for animals with around 45 growth layers or more, in sei whales at around 30 growth layers, and in minke whales at perhaps even fewer layers. This respondent further reported that one could be out by five growth layers in old animals. If present in minke whales, the problem of tight banding would lead to biased (under-estimated) ages for older animals.

Consequences of Not Migrating on Band Formation

An important unanswered question in the interpretation of ear plugs bands is the underlying factor responsible for the formation of bands and the effect that variable patterns in annual migration may have on their formation. The questionnaire included a question seeking opinions on the possible consequences on band formation pattern if an animal did not migrate in a given year – i.e. would such an animal still be expected to form a distinguishable annual band? Two respondents were willing to speculate on this question – noting that that there was no direct information.

One respondent noted that migratory toothed cetaceans maintained in captivity still deposit annual tooth layers and further considered that feeding cycles may be equally as important as migration. This respondent thought that the pattern would persist in non-migrating whales (i.e. an endogenous rhythm), but that it could be less pronounced/clear. The other respondent noted that one could assume an animal over-wintering in the Antarctic might be expected still to show a reasonable patterning, whereas an individual spending the whole year in the tropics might show a less distinct patterning.

General Discussion and Conclusions

Although the sample size was small, the answers from the questionnaire confirm that there are still unresolved issues in the age reading of earplugs from Southern Hemisphere minke whales. The two most significant of these would appear to be:

(1) the assessment of the readability of individual earplugs, and
(2) the undercounting of bands in older animals as the result of tight packing of growth layers.

The consequence of non-migration on the formation of growth layers is also potentially a source of bias in age estimates. However, the two respondents who commented on this speculated that this would not interfere with growth layers being formed, but may impact readability.

The readability of earplugs was also identified as one of the unresolved issues in Polacheck and Punt (2006) based on their reading of the report from the 1984 aging

workshop (IWC, 1984). It should be noted that in terms of the existing minke whale catch-at-age data, the issue relates primarily to the readability of earplugs that have been collected and not ones where the earplugs were not collected or clearly damaged when being collected and transported.

The issue of readability appears to relate to different assessments among readers of whether the pattern of band layering is recognizable, highly irregular, faint and/or obscured by flaws. On respondent to the questionaire considered that a relatively high fraction (i.e. ~50%) of minke whale earplugs show these features, while other respondents considered that such features are rare and/or do not preclude reliable age estimation. It is not clear whether this represents differences in skill (or experience) in determining/distinguishing the annual patterns in minke whale earplugs or a difference in criteria used (i.e. these features are not recognized). In the aging data being used in the catch-at-age analyses, there are a low percentage of collected earplugs that were judged to be unreadable by those that conducted the reading. As such, the issue in the use of these data would be the extent that factors which some readers observe and consider would lead to an earplug to being unreadable could result in biases and errors if in fact age estimation were conducted on them.

The issue of potential undercounting of bands due to the tight packing of growth layers for older animals would have implications for the catch-at-age analyses. How serious an issue this may be is unclear and like the readability issue there appears to be substantial differences in opinion among different readers.

Resolution of both of these issues remains a high priority for the completion of the minke whale catch-at-age analyses. Their resolution will most likely require further collaborative and comparative earplug readings and analyses among readers with different assessments of the extent to which both non-readability and tight packing occur.

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Table 1
Summary of relevant experience of the respondents to the questionnaire.

Respondent	Experience/observed Measuring of Lengths	Experience in Ear Plug Collection	Experience in Age Reading
1	Coastal whaling only	Yes – fin, sei & humpback	No
2	No	Yes – fin and sei	Yes
3	Yes – commercial pelagic whaling	Yes - fin, sei, Bryde's and minke	Yes
4	Coastal whaling only	Yes - fin, sei, hump and blue	No
5	Yes – commercial pelagic whaling	Yes - Right, blue, fin, sei, Bryde's, minke	Yes
6*	Yes – JARPA whaling	Yes – minke plus various species**	Yes (1 researcher)

* collective response from seven researchers
** other species varied among individuals and included fin, Bryde's and sei whales

Appendix 1

THE QUESTIONAIRE

1. Have you participated in pelagic whaling cruises (either commercial or scientific) in which biological data and/or samples were collected on the whales taken?

2. If your answer to question 1 was no, please skip to question 6. Otherwise can you please provide a brief summary of the number of cruises, their duration and location and the approximate number and species whales sampled?

3. Were you involved in or did you observe the procedures used to measure the lengths of whales taken?

4. If your answer to question 3 was no, please skip to question 6. Otherwise, can you briefly describe the procedure used to measure the lengths of whales? If you have been involved in both commercial and JARPA operations, could you please highlight any differences in the procedures used?

5. In measuring the length of whales, did you encounter or observe any problems with respect to ensuring that a "repeatable" straight-line length measurement was obtained (e.g. questions of alignment of the whale and the tape measure, parallax, determination of end points for measuring, ensuring the whale was not curved, etc)?

6. Have you been involved in or observed the sampling of ear plugs for age estimation?

7. If your answer to question 6 was no, please skip to question 12. Otherwise, which species have you had experience with in sampling ear plugs?

8. Can you briefly describe the procedure used to remove earplugs particularly aspects which would affect whether the ear plug was extracted in its entirety and undamaged and the consistency of the procedures overtime? If you have been involved in both commercial and JARPA operations, also please highlight any differences in the procedures used?

9. Was it always possible to determine whether the whole ear plug had been extracted or whether breakage or damage may have occurred to either end of the plug during the extraction process – particularly for minke whales (if you had experience with the extraction of minke whale ear plugs)?

10. For minke whales, were all ear plugs that were damaged retained? If not, which ones were not kept? Were records kept on suspected breakage or damage?

11. If you have been involved in situations with multiple whales being process at the same time, what procedures were used to ensure that ear plugs were

associated with the correct whale? Were there situations that could have led to mis-matching of earplugs with the associated biological data for a whale?

12. Have you been involved in the reading of ages from minke whale ear plugs?

13. If your answer to question 12 is no, please skip to question 17. Otherwise, what factors or characteristics would lead you to characterize an earplug sample as "unreadable"? Are these factors found equally in earplugs of all ages? If not, approximately with which ages are they most common? How frequently have you encounter these factors in the earplugs you examined?

14. In reading earplugs, how frequently have you encountered earplug with missing or damaged tips? What procedure do you adopt for such earplugs – (e.g. classify them as unreadable? Estimate whether the damage would have resulted in a band being lost? Attempt to estimate the number of missing bands? Etc)?

15. How easy is to assess whether the entire earplug is intact or whether the tips have sustained some damage or a small portion may be missing? Does this vary with the age of the earplug and if so for which ages?

16. In reading earplugs, what factors make it difficult to determine the exact number of bands? Do these vary with the number of band (i.e. age of the animal) and in what way? Are there characteristics of the earplugs that would make earplugs from either young or old animals more difficult to obtain an accurate count of the number of bands (e.g. definition and separation of bands)? Please be as specific as you can about age ranges.

17. From your understanding of the processes that underlie the formation of bands in earplugs, what would be the consequences on the band formation pattern if an animal did not migrate in a given year – i.e. would such an animal still be expected to form a distinguishable annual band?

18. Are there any issues or factors not covered above that you think that the population modellers should be aware that could lead to uncertainties (inaccuracies or biases) the in minke whale age and length data?