The western gray whale population is distinct: a response to SC/61/BRG22

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The western gray whale population was depleted to such low levels by commercial whaling that some considered it extinct (Mizue, 1951; Bowen, 1974). As such, gray whales sighted in the western Pacific after the 1930s were, for a period of time, considered to be strays or vagrants from the eastern stock (Nishiwaki and Kasuya, 1970). The publication of reports of catches off the coast of Korea through the first half of the 1960s (Brownell and Chun, 1977), as well as an increased number of sightings off Russia and Japan after that time (Nishiwaki and Kasuya, 1970; Berzin, 1974), eventually caused this hypothesis to be re-evaluated and replaced by the suggestion that a small remnant population of western gray whales remained throughout the 20th century.

Most of what is known today about western gray whales comes from ongoing studies since 1995 of feeding animals off the northeastern shelf of Sakhalin Island, Russia. These studies show that whales photographically identified off Sakhalin have strong site fidelity and return annually to this area; this is particularly true of females with calves (Weller *et al*., 1999). In addition, information gained via biopsy sampling of individuals off Sakhalin has shown them to be genetically distinct from the eastern population (Lang *et al*., 2008a). More recent observations of western gray whales in regions potentially visited by animals from both the eastern and western North Pacific (e.g. the waters off eastern Kamchatka), however, have once again raised questions about the degree to which Sakhalin gray whales are from those in the eastern Pacific as illustrated by paper SC/61/BRG22.

SC/61/BRG22 suggests that the current population of western gray whales is derived from eastern gray whales. It is disappointing that the author of this paper does not offer any data or references to support the conclusions drawn nor does the paper take into account the rather substantial body of work comparing eastern and western gray whales using both mtDNA and microsatellite makers (LeDuc *et al*., 2002; Lang *et al*., 2008a, 2008b). Similarly, the extensive discussions regarding this topic, as reported in numerous reports of the IWC SC and IUCN have also been ignored.

That being said, the idea that the western gray whale population is derived from the eastern population is not a new idea. Nishiwaki and Kasuya (1970) suggested that a specimen from Japan killed by local fishermen had some similar characteristics to eastern gray whales. Here we provide a partial review of information gained from sightings and genetic data which addresses the question of gray whale population differentiation:

1. The observation offered in SC/61/BRG22 that sightings of gray whales off Sakhalin became more common during a time when the eastern gray whale population was increasing is used to suggest that the feeding ground off Sakhalin was established in part as a result of range expansion of the eastern population.

    a. The last known catches off Korea continued through the 1960s confirming the existence of the population (Brownell and Chun, 1977). Some records of gray whales off Russia, Japan, and Korea exist for the 1960s and 1970s (reviewed in Brownell and Weller 2008). A few sightings of western gray whales were reported from the western Okhotsk Sea in the 1960s but these observations are not well known because they were reported only in Russian (e.g. Berzin, 1974).

Aerial observations of a small number of whales off the northeastern coast of Sakhalin began in the early 1980s (Blokhin et al. 1985, Berzin et al. 1990); concerted boat-based studies in that area starting in 1995 have documented continued use of the northeastern Sakhalin area by western gray whales (see Weller *et al*., 2008a). An increase in the number of reported sightings, strandings, and entanglements of gray whales off Japan also started in the 1980s, and records have become more frequent since then (reviewed in Koya *et al*., 2008). It therefore seems most likely that sightings of gray whales in the western Pacific during the 1960s and 1970s were representative of a small number of animals that survived extirpation from commercial whaling and that this population has been increasing slowly.

b. Both mtDNA and bi-parentally inherited microsatellite markers (n=14) have now been used to measure differentiation between eastern and western gray whale populations as well as to compare levels of nuclear genetic diversity retained in each (LeDuc *et al*., 2002; Lang *et al*., 2008b). Mean levels of genetic diversity were similar between the eastern and western populations, suggesting that significant amounts of nuclear genetic diversity have not yet been lost in the small western population. Comparison of microsatellite allele frequencies confirmed that eastern and western populations are genetically distinct ($p<0.001$).

c. The whale entrapped in a set net in Yoshihama Bay, Japan in 2007 was photographically matched to an animal first identified as a calf off Sakhalin in 2006, providing a confirmed link between the Sakhalin feeding ground and a migratory corridor off Japan (Weller *et al*., 2008b). A genetic sample was collected from this whale during the 2006 field season off Sakhalin. Although this whale has a haplotype that is common in both eastern and western sample sets, genetic assignment tests group her (and her mother) with the western cluster of animals. As well, paternity testing assigns this whale a putative father that has been repeatedly identified off Sakhalin; this male is also the putative father of two other calves first identified off Sakhalin. By establishing a connection between the entrapped whale and other whales utilizing Sakhalin, this genetic information adds further support for the link between the feeding ground off Sakhalin and the migratory corridor off the eastern side (Pacific) of Japan.

2. Recent sightings of Sakhalin gray whales in areas potentially utilized by animals from the eastern population (eastern Kamchatka) are used in SC/61/BRG22 to suggest that animals feeding off Sakhalin are part of the eastern population.

   a. The lack of sighting and photo-identification effort off Kamchatka until recent years makes it difficult to assess whether use of this area by Sakhalin gray whales is a new phenomenon or simply was previously undiscovered. If the appearance of Sakhalin whales off eastern Kamchatka represents a recent range expansion of western gray whales (potentially recolonization of areas previously used) it would be consistent with similar shifts in the distribution of feeding eastern gray whales and may be driven by ecological factors. Alternatively, it is also possible that sources of anthropogenic disturbance from oil and gas development activities on or near the Sakhalin feeding ground have displaced whales from, or worse yet, indicates abandonment of what has traditionally been a critical feeding habitat (especially for mother-calf pairs) for the population (Weller *et al*., 2008a).

   b. The sample set used in the genetics studies by Lang *et al*. (2008b) includes 12 samples from gray whales taken in the hunt off Chukotka in 1994. The mtDNA haplotypes of these animals are all haplotypes either found only among the eastern samples or found in higher frequencies in the eastern sample set. Assignment tests group all of these animals with the eastern cluster (although one animal's assignment is somewhat equivocal), suggesting that the gray whales using this region are primarily eastern animals.

c. A genetic sample was collected from a gray whale in August 2004 on the eastern side of the Kamchatka peninsula. This animal was identified as a female and her genotype did not match that of any other sampled animals. The genotype of this sample had a higher probability of belonging to the western population than to the eastern population, supporting photo-identification studies that have shown that some western gray whales use this area during summer months.

d. Although understanding movements of animals between feeding grounds has important implications for management and conservation, genetic "isolation" is dependent on a lack of interbreeding between groups of animals. As such, even if substantial mixing of eastern and western gray whales occurs in feeding areas, isolation could still be maintained if those animals were returning to different areas to breed (Lang *et al*., 2008b).

Recommendations for future work to address these issues are:

Satellite tagging – a major gap in our understanding of the western gray whale population and the threats it faces lies in our lack of knowledge about migratory routes and wintering grounds. Satellite tagging may help to address that lack of knowledge and may provide further information on the discreteness of the western gray whale population. The lack of recent sightings in areas south of Japan further supports this need. On this point we agree with SC/61/BRG22.

Photo-identification comparisons of the western gray whale catalogue with those maintained for eastern gray whales might provide an additional line of evidence to further address questions about the isolation of the western population.

Genetic sampling of animals feeding in areas potentially used by both eastern and western animals would be valuable in assessing the stock identity of those individuals.

Genetic analysis of samples obtained from animals entrapped, stranded, or sighted in other areas of the western gray whale's range other than Sakhalin and Kamchatka (e.g. Japan) would provide useful information to determine the relationship of such animals to those identified off Sakhalin. Similarly, if any historic bone or baleen samples from western gray whales exist, genetic analysis could be used to compare genetic diversity between historic and current western gray whales.

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