Workshop on the Southern right whale die-off at Península Valdés, Argentina

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BACKGROUND

A workshop was held to discuss the ongoing Southern right whale (*Eubalaena australis*) die-off at Península Valdés, Argentina, during the Annual Conference of the International Association for Aquatic Animal Medicine on 23 April 2013 hosted by The Marine Mammal Center, Sausalito, California. This report is a summary of the workshop.

The IWC held a Southern Right Whale Die-off Workshop from 15-18 March 2010 hosted by the Centro Nacional Patagónico (CENPAT) in Puerto Madryn, Argentina (SC/62/Rep1) to review the significant number of right whale calf deaths ongoing at Península Valdés, Argentina (Anon. 2011). The 2010 workshop considered information on stranded animals collected by the Southern Right Whale Health Monitoring Program (SRWHMP), reviewed the biology and population status of the western South Atlantic right whale population, explored ideas for possible causes of mortality and developed three primary hypotheses to explain the high calf mortality: nutritional stress, biotoxins, or infectious disease, or a combination of these factors. The report also drew attention to the increasing incidence of parasitic behaviour of kelp gulls (*Larus dominicanus*), which peck at the outer skin and then feed on the blubber of live whales at Península Valdés, creating large wounds and significantly altering the behaviour of whales, in particular mothers and their newborn calves. The report also noted the increasing prevalence of gull-caused lesions on these whales, and recommended that management measures be taken with respect to kelp gulls displaying this behaviour.

Despite the three years of additional stranding and necropsy effort since the 2010 workshop, the SRWHMP veterinarians and pathologists (Uhart and McAloose) concluded after the 2012 season the data still did not definitively point toward any particular infectious pathology that could explain the high levels of calf mortality. They reached out to participants in the 2010 workshop to seek further discussion of the information in hand and the goals of the SRWHMP. Gulland offered to convene a

Southern right whale die-off meeting to take advantage of the expertise of the marine mammal veterinarians and health experts attending the IAAAM.

SUMMARY OF PRESENTATIONS AND MAIN FINDINGS

In a session on 23 April 2013 (chaired by Thomas), 25-30 veterinary and pathology experts and biologists with expertise on mysticete strandings, met to review the 2010-2012 stranding and necropsy results from the SRWHMP and additional information of relevance to the causative hypotheses, review that information in light of the hypotheses generated at the 2010 IWC SRW die-off workshop, reconsider the evidence on possible causes of mortality, and identify future research directions.

Rowntree presented updated information on the number, timing and location of strandings at Península Valdés. In the three calving seasons since the 2010 workshop, the die-off has continued, at somewhat lower levels in 2010 and 2011, but was the highest ever in 2012, when 116 whales stranded, including 113 calves (97%). From the start of the SRWHMP in 2003 through 2012, 598 strandings were recorded, 91% of them calves. During this period, the SRWHMP conducted 262 necropsies, 151 of which yielded samples for pathological and histological analysis (765 tissue samples of 44 different types were examined). Strandings continued in both the northern gulf of Península Valdés, Golfo San José, and the southern, Golfo Nuevo, with proportionally more dead calves in Golfo Nuevo relative to the numbers of live calves there. Differences amongst years in the timing of peak mortality and corresponding patterns of calf size are examined in a forthcoming paper by Rowntree *et al.* (in review).

Participants noted that similar die-offs have not been reported from elsewhere in western South Atlantic right whale populations, notably including the Brazilian calving and nursery area, nor from other southern or northern right whale populations. Die-offs of similar character or extent have not been recorded for other mysticetes.

Uhart and McAloose of the SRWHMP reviewed results from the stranding, necropsy and diagnostic investigations from 2003-2011. Most of the necropsies and histological analyses were conducted on 2-8 week old calves. No substantive patterns have been found in data from histology, biotoxin, pollutants or infectious disease diagnostics. Currently there are no consistent gross or histological findings or ancillary diagnostic results within or between years to explain the recurrent annual southern right whale deaths at Península Valdés. Satellite chlorophyll data from the past two decades at Península Valdés and at offshore feeding grounds were presented at the meeting (Wilson), and showed that blooms of chlorophyll began to occur in Gulfo San Jose and Gulfo Nuevo in 2004, around the time calves began dying in large numbers. These blooms develop in Sept-Oct, concurrent with the calving period. The species of phytoplankton associated with these blooms are unknown, and they cannot be assumed to be harmful. No clear temporal associations between plankton blooms and mortality patterns have been identified within years and only trace levels of biotoxins were found in four of 36 whales examined. Data provided on contaminant levels in right whales supported the 2010 workshop's conclusion that contaminants are not a likely factor (contaminants in baleen whales tend to be an order of magnitude lower than toothed cetaceans). The most consistent pattern in the gross necropsy findings for the 151 calves

examined was the presence of gull attack lesions in 53 of them (although this number does not indicate the percentage of the 147 dead calves examined that had the dorsal surface exposed and sufficiently intact to allow identification of such lesions).

Sironi presented new preliminary information on the extent of gull lesions on the dorsal surface of live and dead whales. He categorized the extent of lesions (on a scale of 1 to 5) for 154 dead calves (of a total sample of 411 dead whales from 2008-2012) that stranded with the back visible. In years of high calf mortality (such as 2012) 52% of these calves had a high or very high number of gull lesions (25 or more in some cases) and only 26% were without lesions. Gull lesions on stranded calves were least in 2010 (56%), the year of lowest calf mortality in this period. The percentage of calves with a high or very high number of gull lesions was much greater in Golfo Nuevo (46%), where a larger proportion of calves died, than in Golfo San José (8%). Photos of live whales of all ages from aerial surveys showed that the percentage of individuals with gull lesions increased from 1% in 1974, to 37.8% in 1990, 67.6% in 2000 and 76.8% in 2008. Gull attack frequency increased in both gulfs from 1995 to 2012 with the larger increase in Golfo Nuevo, where in some years (2011) whales were attacked 39% of the time, three times the level observed in 1995 (12%).

Sironi recalled that adult whales, especially mothers, have adapted to the increasing gull attacks by adopting postural changes that reduce the area of their backs exposed to gulls (Rowntree *et al.* 1998; Thomas 1988). Calves, on the other hand, have little behavioural recourse but to react to gull attacks with high energy alarm or flight. Unlike their mothers, the calves continue to be pecked by gulls despite their response behaviors. Sironi presented information illustrating the direct positive relationship between the level of gull attacks in different years and the percentage of time right whales spend in high energy gull attack avoidance (e.g., increased swimming speed, breaching, tail and flipper slapping, etc). In a 1995 study, time spent travelling at medium to fast speeds increased three-fold for mother-calf pairs attacked by gulls compared to pairs that were not attacked and their time resting decreased by 20%. The increase in gull attacks from 1995 to 2011 has probably greatly increased the amount of energy mother-calf pairs expend in gull attack response and, correspondingly, reduced the time spent resting or travelling slowly. Sironi noted that the parasitic behavior of kelp gulls on southern right whales has not been observed in any other location, with the exception of two isolated cases recorded off the coast of Brazil (Groch 2001).

Marón presented ongoing studies of the diet and body condition of southern right whales conducted through fatty acid profiles from blubber and milk samples from dead calves (204) and blubber biopsies (30) from living mother-calf pairs. These are being compared to fatty acid profiles found in Patagonian copepods and Antarctic krill to determine maternal diet composition. Blubber thickness measurements of 186 calves that died between 2003-2012, were analyzed to determine whether calves were in poor body condition. Anal-dorsal region blubber thickness was significantly greater in years with low calf mortality (2003, 2004, 2006) compared to high mortality years (2005, 2007-2012). Further investigations of possible hormonal and metabolite evidence of malnutrition are ongoing.

DISCUSSION AND GENERAL CONCLUSIONS

In light of the lack of evidence from partial and complete necropsies for the three primary hypotheses from the 2010 workshop and the strong signal of gull attacks as a unique, increasing, and acute element of the lifecycle of young right whale calves at Península Valdés, workshop participants focused on the possible mechanisms by which gull attacks could lead to death of right whale calves. Participants considered that the physical injury of extensive gull lesions can compromise the integrity and impermeability of the whale's surface layers and lead to dehydration, loss of thermoregulatory capacity, and increased energy outlay to wound healing and metabolic stasis. Documented behavioral consequences of gull attacks include increased high energy reactive or flight behavior and reduced time resting. Constant gull attacks and calf flight activity have supplanted the "normal" quiescent patterns of calf rest, nursing bouts and play recorded at Península Valdés in more undisturbed conditions in the 1970's (Thomas and Taber 1984) and may reduce the ability of calves to receive sufficient nourishment from their mothers and add extensive physical injury and its consequences to the individual life histories of young calves. It is possible that increasing gull attack frequency and the level of physical and behavioral disturbance of right whales has reached a threshold level in recent years above which some calves may be driven to death, leading to the high calf mortality levels observed since 2005.

Workshop participants agreed that a fourth hypothesis should be developed to guide evaluation of the possible contribution of gull attacks to the ongoing calf mortality at Península Valdés. A preliminary statement of this hypothesis is: high levels of harassment by kelp gulls that peck on a calf's exposed skin and then feed on the underlying blubber, cause significant physical injuries, energetically expensive avoidance behavior, and reductions in suckling time. This syndrome may result in, *inter alia*, decreased food intake, increased energy expenditure, exhaustion, catabolism, dehydration, and thermoregulatory stress, with cumulative and cascading effects that can lead to calf death.

Some participants suggested that an increasing factor of gull-attack mortality might overlie a "normal" increase in the number of calf deaths in line with the rate of population increase of this population over the last several decades. This might account for the percentage of calves that strand without significant gull lesions and the preliminary observation (limited to 2010) of fewer dead calves with lesions in some lower mortality years.

Participants committed to further development of the gull-attack hypothesis, including by reference to similar phenomena of "fly worry" or insect harassment of terrestrial ungulates (Elkan *et al*. 2009), and exploration of the possible contribution of injury, behavioral, and nutritional elements of gull attacks to calf decline and death. This will help to guide analyses of previous gull attack-related observations and assist in designing future research on dead calves, live whales, and gulls.

Finally, participants emphasized the strength of epidemiological "signal" of the gull attacks and gull-attack lesions in the right whale calf die-off. They voiced concerns over

the harmful nature of these gull attacks that amplified those of the 2010 SRW die-off workshop (Anon. 2011) and the 2010 meeting of the IWC Scientific Committee. Participants also noted the significance of the gull attacks as a welfare issue for right whale calves. Information on the extent or success of gull-control efforts conducted in 2012 by the Provincial Government of Chubut and CENPAT researchers was available only from local newspapers (that reported 175 gulls shot in 27 boat trips in 2012), but there was strong support for such efforts at the meeting. The workshop participants noted the hard work of the SRWHMP team and agreed with the statement in the 2010 SRW die-off workshop report (Anon. 2011) acknowledging "the considerable efforts of the researchers in Argentina (and abroad) to investigate the die-offs and commended them on their accomplishments to date in the face of fiscal and logistical constraints and in view of the sheer number of dead whales." Participants also noted that the Southern Right Whale Health Monitoring Program has created the most complete necropsy data base and biological sample collection for this species, and strongly recommend support for the long-term continuation of the Program.

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