

1 **Title: How we all kill whales**

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4 **Abstract**

5 Today there is enormous popular interest in marine mammals. Western media tend to dwell on  
6 the ongoing debate about commercial whaling by Japan, Norway and Iceland. There is, however,  
7 relative silence as to how the shipping and fishing industries of many if not all maritime  
8 countries are also catching and sometimes killing whales, albeit unintentionally. Thus, western  
9 countries have, through the development and increase in fishing and shipping in continental shelf  
10 waters, essentially resumed whaling as vessel speeds and fishing gear strength have increased in  
11 recent decades. The ways in which these animals die, especially in fixed fishing gear that they  
12 become entangled in and swim off with, would raise substantive concern with consumers of  
13 seafood were they to be aware of what they were enabling.

14 Keywords: Whaling. Entanglement. Bycatch. Mortality. Animal welfare.

15 **Introduction**

16 In the summer of 1983 my first job out of veterinary school was as an observer for the  
17 International Whaling Commission examining the efficacy of explosive harpoons for killing fin  
18 whales on an Icelandic whaling vessel (Lambertsen and Moore, 1983). Later, I encountered a  
19 very different way of killing whales. A North Atlantic right whale was first sighted entangled in  
20 fishing gear in May of 1999. Five months later it was dead off Cape May, New Jersey, USA. The  
21 entangling rope and gillnet had dissected off the blubber on its back (Fig. 1) while it was still  
22 alive. The necropsy report, page 1 (Early and St Aubin, 1999) includes the following description:

23 *Rope and gillnet tightly wrapped around both pectoral flippers, and a single line was*  
24 *stretched tightly over the dorsum between the two flippers. The full thickness of the skin*  
25 *and blubber was absent over the dorsal thorax, as though the line had incised the blubber*  
26 *to the fascia, then migrated posteriorly, flensing the animal as it worked its way along.*  
27 *The tautness of the line which now rested against the muscular body wall was consistent*  
28 *with the extreme tension that must have been required to cut through the integument. The*  
29 *missing section of skin and blubber measured 1.4 m at its widest mid dorsally and*  
30 *tapered to narrower points dorsal to each pectoral flipper, but nevertheless exposing both*  
31 *scapulae.*

32 These two very contrasting scenarios of how humans kill whales have preoccupied me ever 32  
33 since. The whalers were intent on killing for profit, and did so with remarkable efficiency. My 33  
34 primary and sincere concerns as a scientist centred on whether the hunt was sustainable. In 34  
35 contrast, the entangled animal was killed without intent, but in addition to concerns about the 35  
36 loss of this individual member of an endangered species, the veterinarian in me was extremely 36  
37 concerned about the animal's welfare while it was taking five months to die. Yet some advocates  
38 37 in the US, UK, Australia and other countries criticise Japan, Iceland and Norway for their 38  
39 commercial whaling, while ignoring the unintentional killing of whales in many countries, 39

40 including all of those listed in this sentence. The idea that individuals should judge another  
41 nation's motivations and methods of killing whales, struck and strikes me as being far from clear  
42 41 ethically.



43  
44 Figure 1. Female North Atlantic right whale (*Eubalaena glacialis* - Catlog # 2030), 13.5 m long.  
45 First sighted June 29th 1990. First sighted entangled May 10th 1999. Last seen alive, September  
46 13th 1999. Sighted dead October 20 1999 (Conger and Knowlton, 1999). The wound in the  
47 blubber coat dissected off by the rope and gillnet stretched over the dorsum between the two  
48 flippers is clearly visible. The skin has been lost through decomposition exposing white blubber.  
49 Photo Credit - Lisa Conger - New England Aquarium.

50  
51 In this essay, I will explore the conservation and welfare factors at work in these two ways that  
52 man kills whales today, whether by intent or not. I will focus primarily on commercial whaling  
53 and entanglement, but recognize that there are other topics that could be included, such as  
54 scientific and aboriginal whaling, euthanasia of living stranded whales, lethal and sublethal  
55 vessel strikes and the effects of ocean noise and contaminants on whales. But before going  
56 further, I point out that the word whaling is defined in the Oxford English Dictionary as "the  
57 action, practice or business of catching whales". Importantly, this means that the unintentional  
58 capture and killing of whales is, by that definition, whaling. I will discuss whaling for profit  
59 (commercial whaling) and whaling by default (fishing gear entanglement). Further, before critics  
60 of commercial whaling respond that fishing gear entanglement is fundamentally different to  
61 commercial whaling, they should remember that whenever fixed fishing gear is set in areas that  
62 are known to be frequented by large whales, there is a probability (that is gear and species  
63 dependent) that whales will get captured by the gear and that these encounters will affect the  
64 whale's welfare and sometimes be lethal (Cassoff et al., 2011). Many of these animals if large  
65 enough to break out are subsequently 'released' as they swim off with the entangling gear,  
66 however, as with other catch and release fisheries (Bartholomew and Bohnsack, 2005) and other  
67 commercial fishery bycatch release (Davis, 2002), survival is by no means assured. Likewise,  
68 some vessel collisions with whales also involve capture, such as when rorquals are caught on the  
69 bulbous bows of large ships and brought to port dead (Norman et al., 2004). I should also  
70 acknowledge that there are other welfare concerns both for fish being harvested and for the  
71 harvesters. I will not consider either of those substantive subjects in this essay.

72

### 73 **Whaling by Design**

74 Killing whales with harpoons and associated tools has been commercially profitable for at least  
75 1000 years, since King Sancho (the Wise) of Navarre levied a tax on baleen plates in 1150 in the  
76 city of St Sebastien (Markham, 1881). This early Basque harvest, and the commercial extinction  
77 of the North East Atlantic stocks of right whales before American whaling even became a  
78 business, was the first of many boom and bust cycles.

79 Open boat whaling evolved from shore based whaling to European and American whaling from  
80 larger mother vessels offshore (Reeves et al., 2007). These fisheries relied primarily on handheld  
81 harpoons, using drag to tire a whale to enable delivery of lances to vital organs in the chest. Such  
82 events could take hours to complete and many animals were struck but not killed.

83 The explosive harpoon and faster vessels later enabled wholesale, sequential devastation of  
84 balaenopterid and sperm whale stocks around the world (Tonnessen and Johnsen, 1982). Most of  
85 the concern at that time was with loss of stocks, many of which have yet to recover significantly  
86 (Clapham et al., 1999; Magera et al., 2013). It was only in recent decades that the nature of the  
87 death caused by an explosive harpoon became a central theme of some anti-whaling protests  
88 (Brakes et al., 2004). The message was a mixed one: hunting whales is cruel; there are not  
89 enough of them. Studies of the efficacy of explosive harpoons have shown them, at least in some  
90 cases, to be comparable to other hunting methods (Lambertsen and Moore, 1983; Knudsen and  
91 Oen, 2003). However, many NGO's and conservation-minded bureaucracies have highlighted  
92 welfare concerns in the hope of reducing whaling mortality, when really, the bigger questions  
93 are: 1) For a given species and stock, are there sufficient animals to sustain a given mortality,  
94 given our limited ability to adequately estimate whale population size? 2) Can we manage  
95 whaling to ensure its sustainability, given (a) our historical abject failure to do so; and (b) our  
96 inability to manage many, if not most, high-seas fisheries for sustainability today? The answer to  
97 these questions remains an emphatic 'No'.

### 98 **Whaling by default**

99 In addition to understanding the realities of commercial whaling, it is also important to consider  
100 other ways that humans unintentionally kill whales. The general case for concern for marine  
101 mammal conservation over and above direct harvests from whaling and sealing was made well  
102 by Hofman (1995), who outlined the major conservation threats: vessel strike, fishery bycatch,  
103 marine debris, food chain effects, oil and chemical spills, noise and unusual mortalities. A  
104 detailed conservation action plan was published by IUCN (Reeves et al., 2003). Further, the  
105 diagnosis of, and case definitions for, vessel and entanglement trauma have recently been  
106 published for cetaceans and pinnipeds (Moore et al., 2013) and a case series of chronic large  
107 whale entanglement mortalities has recently been published (Cassoff et al., 2011). Here, I focus  
108 on entanglement as it is a major conservation and welfare issue for large whales.

### 109 **Entanglement**

110 The scale of mostly pinniped and cetacean mortalities from acute fishing gear bycatch  
111 entanglement has been estimated to be hundreds of thousands of individuals per year (Read et  
112 al., 2006). This probably fails to account for the majority of large whale entanglement

113 mortalities. Large whales are often powerful enough to break free from the anchored fishing gear  
 114 and swim off, with residual gear around their appendages. This gear adds substantial drag, and  
 115 over time if the animal cannot shed the gear, or be disentangled by humans, the drag depletes  
 116 energy reserves, and ultimately the animal dies. Such mortalities are certainly underestimated,  
 117 for three reasons: 1) most balenopterid whales such as blue and fin whales are negatively  
 118 buoyant and sink on death but they may refloat after decomposition gases have accumulated; 2)  
 119 right and bowhead whales, although normally buoyant on death can also sink if they are  
 120 sufficiently lipid depleted that they are also negatively buoyant; and 3) many offshore  
 121 entanglement events and sequelae are never reported or sighted, given lack of onshore winds or  
 122 currents in many areas. On the eastern North American Continental shelf death by entanglement  
 123 in fishing gear is on aggregate the most common diagnosed cause of death among 323  
 124 individuals from eight large whale species: 18% entangled, 10% vessel struck, 14% non-human  
 125 related, and 57% undiagnosed in a sample of 323 animals (Table 2 (van der Hoop et al., 2013b).  
 126 In contrast to commercial and aboriginal whaling, and vessel strike, the time to death for whales  
 127 that do not drown acutely can be extremely prolonged. Fatally entangled right whales can take an  
 128 average of six months to die (Moore et al., 2006). An example is shown in Figure 1. This has  
 129 been described as a very serious animal welfare concern (Moore and van der Hoop, 2012).  
 130 Furthermore, there are many cases of persistent sub-lethal entanglement in North Atlantic right  
 131 whales. Knowlton et al. (2012) page 293, summarize their analysis of data for the period 1980-  
 132 2009:

133 *Photographs of 626 individual whales were assessed and 1032 unique entanglement*  
 134 *events were documented. Of the 626 animals, 519 (82.9%) had been entangled at least*  
 135 *once and 306 of the 519 (59.0%) had been entangled more than once. Males and*  
 136 *females were entangled at similar rates. Juveniles were entangled at a higher rate than*  
 137 *adults. On average, 25.9% of adequately photographed animals acquired new wounds*  
 138 *or scars from fishing gear annually with no significant trend over time detected.*

139 There are about 500 North Atlantic right whales in existence currently (Pettis, 2013). The  
 140 population is growing slowly, but sub lethal effects are astoundingly extensive and a major  
 141 welfare concern. Another way to think about this is that the majority of North Atlantic right  
 142 whales are repeatedly more restrained than any animal in a zoo. These data on entanglement  
 143 morbidity and mortality support the concept that right whale habitat on the eastern North  
 144 American Continental shelf is fully industrialized (Kraus and Rolland, 2007). We tend to talk  
 145 about the ocean as wilderness yet, in this area and others, it is far from that, being the focus of  
 146 industries that kill whales by design and default, in addition to many other industrial impacts  
 147 such as energy extraction.

148

## 149 **Conclusions**

150 Man has been killing whales for millennia, and with increasing effectiveness when being killed  
 151 intentionally. The explosive harpoon has been a major factor in that advance. This efficient  
 152 killing method lead to the near extinction of major large whale stocks in both hemispheres.  
 153 Unintentional whale killings have grown to be of substantial concern both in terms of marine  
 154 mammal stock conservation, but also through the way in which the animals die. Drowning in  
 155 nets for small cetaceans and pinnipeds is of course a concern. This has in the past been

156 successfully mitigated by changing fishing practice such as in the tuna/dolphin interactions in the  
 157 Eastern Pacific (Perrin, 2004). But the least humane way to die occurs when the large whales are  
 158 powerful enough to break out of the fixed gear that entangles them, swimming off and dragging  
 159 the gear for months, or where smaller animals are cut out of gear but are still entangled such as  
 160 is commonly seen with pinnipeds with gillnets fragments encircling their necks (page 24 (Barco  
 161 and Moore, 2013). As these animals grow, they become increasingly constricted by the neck  
 162 entanglement, at times lacerating the trachea (personal observation). For the large whales it is  
 163 drag that is the likely source of their ultimate demise (van der Hoop et al., 2013a), slowly  
 164 draining them of energy to swim and fight infections. Palliative measures have included removal  
 165 of entangling fishing gear by trained disentanglement teams (IWC, 2010), with recent  
 166 substantive focus and support for international training by the International Whaling  
 167 Commission (IWC, 2011). However only 10% of documented entanglements, as evidenced by  
 168 entanglement scars, are actually observed as whales carrying fishing gear (Knowlton et al.,  
 169 2012). Thus prevention of entanglement is the only lasting solution, given the difficulty of  
 170 disentanglement. Prevention measures have largely hinged on gear modification, such as sinking  
 171 ground lines and breakaway links (NOAA, 2014).

172 Thus, citizens of nations that undertake substantial fishing in marine mammal habitat could  
 173 consider these pressing domestic issues while also encouraging whaling nations to reconsider the  
 174 substantive sustainability concerns that their industries raise. In the United States there have been  
 175 at least eight management actions designed to reduce large whale entanglement on the US east  
 176 coast (see Appendix Table S1 (van der Hoop et al., 2013b). Yet the problem only seems to be  
 177 escalating. This failure stems from an inability to effectively test proposed solutions prior to their  
 178 deployment. There needs to be a fundamental shift in terms of fishery management for mitigating  
 179 whale entanglement not only using tested, practical, safe and effective gear modification, but  
 180 also by focusing on keeping the gear and the whales separate in time and space, as proposed by  
 181 Myers et al. (2007). Such a proposal may seem radical and unacceptable from a fishing industry  
 182 perspective, however it would create Marine Protected Areas that could serve fishery as well as  
 183 marine mammal conservation agendas (Agardy et al., 2003; Jones, 2007). Thus, wherever there  
 184 is substantive deployment of fishing gear around the world, there is unintended but inevitable  
 185 whale mortality of concern both in terms of welfare and population sustainability. Whaling, by  
 186 design or by default, should be scrutinized carefully.

187

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