Woods Hole Oceanographic Institution
Report to the Marine Mammal Center
October 2013

Estimating Drag Forces and Energetics in Free-Swimming Entangled Whales

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In 2011, we received generous support from WHOI's Marine Mammal Center to estimate drag forces on free-swimming entangled whales and to quantify their energetic impact.

Background

Entanglement in fishing gear is the leading detected cause of death in large whales in the Northwest Atlantic (van der Hoop et al. 2013a). Entanglement may become protracted when individuals break free and carry a portion of the entangling gear, often for months to years (Moore et al. 2006, Moore and van der Hoop 2012). The outcome depends on gear configuration and its load relative to body size (Feldkamp et al. 1988, Yoshida et al. 1990); the age, stage, and health of the individual at the time of entanglement; and the severity and duration of the event. While chronic impacts of entanglement include systemic infection and debilitation due to severe tissue damage, many protracted entanglements become terminal due to starvation and emaciation due to the inability to cope with a drag-induced negative energy budget. The energetic consequences associated with drag from towing entangling gear have only recently begun to be quantified (van der Hoop et al. 2013b).

Progress

With support from the MMC, we were able to purchase a Little Leonardo 3MPD3GT data-logger. This device's ability to measure speed with an external propeller, in addition to pressure and three-axis acceleration, is critical to measuring drag. Salary support allowed for van der Hoop to spend one month in Longue-Pointe de Mingan, Quebec, Canada to obtain hands on experience in preparing, deploying, collecting, and maintaining the tags, as well as analyzing the data they record in collaboration with Mingan Island Cetacean Study (MICS) and the University of St. Andrews.

These funds supported van der Hoop's salary during the preparation and publication of the initial opportunistic study that spurred this MMC proposal (van der Hoop et al. 2013b). This paper was highlighted by a variety of media sources, including radio (Canadian Broadcasting Company's Quirks and Quarks), news (Cape Cod Times) and print journalism (ScienceNOW, Science Daily).

Finally, these MMC funds supported field work above the RV Tioga for the deployment of 15 sets of fishing gear removed from entangled right whales with detailed catalogue history (Figure 1). Towing gear behind a vessel and measuring drag forces via tensiometer has provided a first glimpse at the drag forces associated with specific gear configurations(van der Hoop et al. 2013b). The measurements obtained from these sets of fishing gear, and from the standard telemetry buoy used to track entangled whales, will allow us to empirically derive the drag associated with towing accessory gear as a function of depth and tow speed (Figure 1).

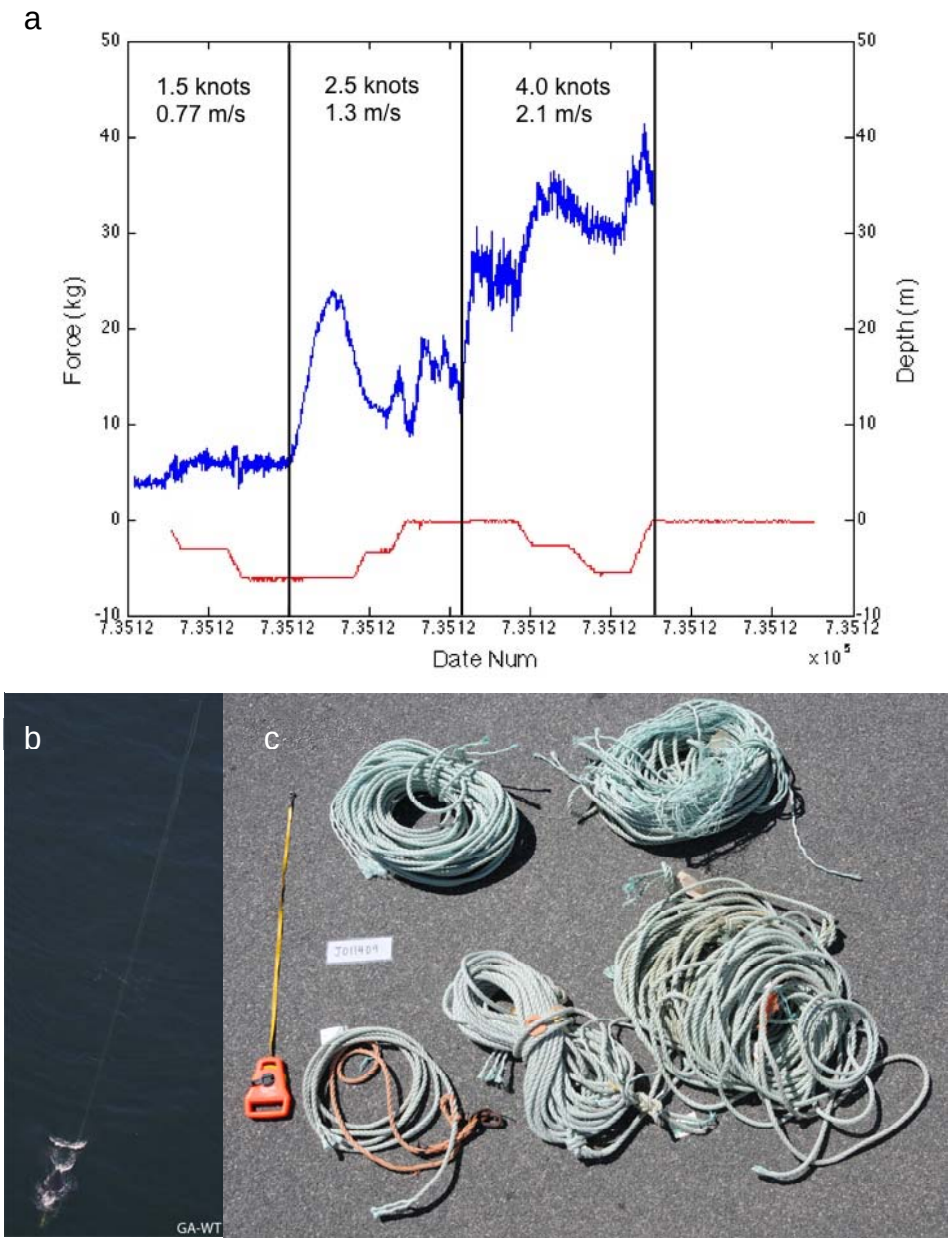

Figure 1 - Right whale Eg#3311: a) Raw measured drag force (blue) at varying depth (red) and vessel speed through the course of a tow, for entangling gear removed from Eg#3311.); b) Entangled animal (observed Jan 14 2009); and c) gear removed Jan 14 and Mar 6 2009 (approx. 275 m length, 26.85 Kg dry weight).

Impacts

We have begun to quantify the drag imposed by towing accessory fishing gear in free-swimming large whales. Further analyses of data obtained with MMC support will:

- Increase understanding of the expected timelines and survivability of entanglement events, to better address response;
- Provide a sharper focus on the true cost of entanglement in terms of individual condition and fecundity, potentially enabling an enhanced focus on sub-lethal entanglements as sources of 'Serious Injury' in the context of relevant US federal laws;
- Determine the effect of sub-lethal entanglement on population growth rates;
- Inform disentanglement operations in terms of how to minimize the drag from intractable cases.

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