# Addendum to the Draft IHA Application for a Marine Seismic Survey of the Arctic Ocean U.S. Geological Survey in 2010

This addendum supplements the Incidental Harassment Authorization Application (IHAA) for the proposed marine seismic survey of portions of the Arctic Ocean to be conducted by the U.S. Geological Survey (USGS) in the late summer-early fall of 2010. USGS conducted early coordination with the National Marine Fisheries Service (NMFS) and solicited their comments on the preliminary draft of the subject EA. Supplemental information to the draft EA was requested by NMFS to address potential marine mammal "takes" from icebreaking activity intrinsic to the project.

Icebreaking is considered by NMFS to be a continuous sound and NMFS (2005) indicates the existing threshold for Level B harassment by continuous sounds is a received sound level of 120 dB SPL. Potential takes of marine mammals may ensue from the icebreaking activity in which the USCGC *Healy* is expected to engage outside of U.S. waters, i.e. north of ~74.1°N. While breaking ice, the noise from the ship, including impact with ice, engine noise, and propeller cavitation, will exceed 120 dB continuously. The draft EA presents take estimates based exclusively on the seismic survey component of the project within U.S. waters. If icebreaking does occur in U.S. waters, we expect it will occur during seismic operations. The safety radius for the marine mammal Level B harassment threshold during the proposed seismic activities is greater than the calculated radius during icebreaking. Therefore, if the *Healy* breaks ice during seismic operations within the U.S. waters, the greater radius, i.e. that for seismic operations, supersedes that for icebreaking, so no additional takes have been estimated within U.S. waters. This addendum presents calculations of exposures to marine mammals due to icebreaking only outside U.S. waters when the USCG *Healy* will be breaking ice for the *Louis S. St. Laurent*.

It is important to note that non-icebreaking vessels, as well as natural sounds such as those arising from sea ice motion and whale flukes hitting the ocean surface, also present similar sound impacts. Underwater noise from various vessels, including tug boats, oceanographic research vessels, and fisheries research vessels in open water, as well as icebreakers traversing sea ice, often exceed 120 dB, the existing threshold for Level B harassment set by NMFS (2005).

The sound level and other estimates provided in this addendum are for information purposes only and do not represent any conclusions with regard to harassment. Further studies are needed before a precedent can be established.

The objectives and plans of the proposed project remain unchanged. The following includes specifics of the estimation of trackline while the USCGC *Healy* breaks ice outside U.S. waters and the calculation of the resulting potential takes. The supplemental information has been organized in a manner consistent with the draft IHAA. The estimated takes provided in this addendum are in addition to the number of estimated takes due to seismic activities within U.S. waters that are presented in the Incidental Harassment Authorization (IHA) Application submitted to the NMFS on 28 May 2010.

## II. Dates, Duration, and Region of Activity

The proposed geophysical survey will be conducted for ~28 days from approximately 7 August to 3 September 2010. Icebreaking outside U.S. waters will occur between the latitudes of ~74 to 84 °N. Vessel operations and ice conditions from similar survey activities and timing in 2008 and 2009 were used to estimate the amount of icebreaking (in trackline km) that is likely to occur in 2010.

We expect that the *Louis S. St. Laurent* and the *Healy* will be working in tandem through the ice for a maximum of 23–25 days while outside U.S. waters. The average distance travelled in 2008 and 2009 when the *Healy* broke ice for the *Louis S. St. Laurent* was 135 km/d (Table Add-1). Based on the 23–25 day period of icebreaking, we calculate that, at most ~3102–3372 km of vessel trackline may involve icebreaking. This calculation is likely an overestimation because icebreakers often follow leads when they are available and thus do not break ice at all times.

Table Add-1. Projected 2010 icebreaking effort for USGS/ GSC 2010 Extended Continental Shelf Survey in the northern Beaufort Sea and Arctic Ocean.

| ` | **2-ship operations (days)** | **2-ship operations (km)** | **km/day** |
|---|---|---|---|
| 2008 | 19 | 2469 | 130 |
| 2009 | 27 | 3774 | 140 |
| Avg. 2008-2009 | 23 | 3122 | 135 |
| **Projected 2010** | **23-25** | **3102-3372** | -- |

## IV. Status, Distribution and Seasonal Distribution of Affected Species or Stocks of Marine Mammals

Within the latitudes of the proposed survey when the *Healy* will be breaking ice outside of U.S. waters, no cetaceans were observed by marine mammal observers (MMOs) along approximately 21,322 km of effort during projects in 2005, 2006, 2008 and 2009 (Haley and Ireland 2006, Haley 2006, Jackson and DesRoches 2008, Mosher et al. 2009). The estimated maximum amount of icebreaking outside of U.S. waters for this project, i.e. 3372 line km, is considerably less than the combined trackline for the aforementioned projects. At least one MMO will stand watch at all times while the *Healy* is breaking ice for the *Louis S. St. Laurent.* We do not expect that MMOs will observe any cetaceans during the proposed survey.

Seals were reported by MMOs during the 2005, 2006, 2008 and 2009 effort within the latitudes of the proposed survey (Table Add-2).

TABLE Add-2. Number of pinnipeds reported during 2005, 2006, 2008 and 2009 projects within the latitudes where the *Healy* will be breaking ice outside of U.S. waters for the proposed Arctic Ocean survey (Haley and Ireland 2006, Haley 2006, Geological Survey of Canada [GSC] unpubl. data 2008, Mosher et al. 2009).

| Species | No. of Sightings | No.of Individuals |
|---|---|---|
| ***Pinnipeds*** | | |
| Ringed seal | 116 | 125 |
| Bearded seal | 24 | 26 |
| Unidentified seal | 128 | 140 |
| ***Totals*** | 268 | 291 |

# VII. ANTICIPATED IMPACT ON SPECIES OR STOCKS

## *Numbers of Marine Mammals that Might be "Taken by Harassment"*

All anticipated takes would be "takes by harassment", as described in § V of the original application, involving temporary changes in behavior. The mitigation measures to be applied will minimize the possibility of injurious takes. (However, as noted in Appendix D of the original application, there is no specific information demonstrating that injurious "takes" would occur even in the absence of the planned mitigation measures.) The sections below describe methods used to estimate "take by harassment" and present estimates of the numbers of marine mammals that might be affected during the proposed seismic study in the Arctic Ocean.

Few data (systematic or otherwise) are available on the distribution and numbers of marine mammals in the northern Beaufort Sea or offshore water of the Arctic Ocean. Both "maximum estimates" as well as "best estimates" of marine mammal densities (Table Add-3) and the numbers of marine mammals potentially exposed to underwater sound (Table Add-4) were calculated as described below. The best (or average) estimate is based on available distribution and abundance data and represents the most likely number of animals that may be encountered during the survey, assuming no avoidance of the airguns or vessel. The maximum estimate is either the highest estimate from applicable distribution and abundance data or the average estimate increase by a multiplier intended to produce a very conservative (over) estimate of the number of animals that may be present in the survey area. There is some uncertainty about how representative the available data are and the assumptions used below to estimate the potential "take by harassment". However, the approach used here is accepted by NMFS as the best available at this time.

The following estimates are based on a consideration of the number of marine mammals that might be disturbed appreciably over the ~3102–3372 line kilometers of icebreaking that may occur during the proposed project as described above .

**Marine Mammal Density Estimates**

Numbers of marine mammals that might be present and potentially disturbed are estimated below based on available data about mammal distribution and densities in the area. "Take by harassment" is calculated by multiplying the expected densities of marine mammals likely to occur in the survey area by the area of water potentially ensonified to sound levels ≥120 dB re 1 µPa (rms). This section provides descriptions of the estimated densities of marine mammals that may occur in the survey area.

No published densities of marine mammals are available for the region of the proposed survey between 74°N and 84°N where the *Healy* will be breaking ice outside U.S. waters. However, vessel-based surveys through the general area in 2005, 2006, 2008 and 2009 encountered few marine mammals as described in § IV in the original application. MMOs recorded 268 sightings of 291 individual seals along ~21,322 km of monitored trackline between 74°N and 84°N (Haley and Ireland 2006, Haley 2006, GSC unpubl. data 2008, Mosher et al. 2009). No cetaceans were observed during the surveys between 74°N and 84°N.

Given the few sightings of marine mammals along the ~21,322 km vessel trackline in previous years, we estimate that the densities of marine mammals encountered while breaking ice will be 1/10 of the estimated densities of mammals that may be encountered within the ice margin habitat described in the original application (Table Add-3).

TABLE Add-3. Expected summer densities of marine mammals in ice margin (from the original application) and polar pack ice habitats in the Arctic Ocean. Densities are corrected for *f*(0) and *g*(0) biases. Species listed as endangered are in italics.

| | Ice Margin | | Polar Pack | |
|---|---|---|---|---|
| **Species** | **Average Density (# / km$^2$)** | **Maximum Density ( # / km$^2$)** | **Average Density (# / km$^2$)** | **Maximum Density ( # / km$^2$)** |
| **Odontocetes** | | | | |
| Beluga | 0.0354 | 0.0709 | 0.0035 | 0.0071 |
| Narwhal | 0.0000 | 0.0002 | 0.0000 | 0.0001 |
| **Delphinidae** | | | | |
| Killer whale | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| **Phocoenidae** | | | | |
| Harbor porpoise | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| **Mysticetes** | | | | |
| *Bowhead whale* | 0.0061 | 0.0122 | 0.0006 | 0.0012 |
| Gray whale | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| Minke whale | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| *Fin whale* | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| *Humpback whale* | 0.0000 | 0.0001 | 0.0000 | 0.0001 |
| **Pinnipeds** | | | | |
| Bearded seal | 0.0128 | 0.0512 | 0.0013 | 0.0051 |
| Spotted seal | 0.0001 | 0.0004 | 0.0000 | 0.0000 |
| Ringed seal | 0.2510 | 1.0040 | 0.0251 | 0.1004 |

## Potential Number of "Takes by Harassment"

### *Best and Maximum Estimates of the Number of Individuals that may be Exposed to ≥120 dB rms from Icebreaking*

Numbers of marine mammals that might be present and potentially disturbed are estimated below based on available data about mammal distribution and densities in the Arctic Ocean during the summer as described above.

The number of individuals of each species potentially exposed to received levels ≥120 dB re 1 μPa (rms) by icebreaking was estimated by multiplying

- the anticipated area to be ensonified to ≥120 dB, by
- the expected species density

Some of the animals estimated to be exposed to sound levels ≥120 dB re 1 μPa, particularly migrating bowhead whales, might show avoidance reactions before actual exposure to this sound level (Appendix D). Thus, these calculations actually estimate the number of individuals potentially exposed to ≥120 dB rms that would occur if there were no avoidance of the area ensonified to that level.

***Estimated Area Exposed to ≥120 dB rms***

The area potentially exposed to received levels ≥120 dB due to icebreaking operations was estimated by multiplying the anticipated trackline distance breaking ice by the estimated cross-track distance to received levels of 120 dB caused by icebreaking.

In 2008, acousticians from Scripps Institute of Oceanography Marine Physical Laboratory and University of New Hampshire Center for Coastal and Ocean Mapping conducted measurements of sound pressure levels (SPL) of *Healy* icebreaking under various conditions (Roth and Schmidt 2010). The results indicated that the highest mean sound pressure level (SPL; 185 dB) was measured at survey speeds of 4 to 4.5 kt in conditions of 5/10 ice and greater. Mean SPL under conditions where the ship was breaking heavy ice by backing and ramming was actually lower (180 dB). In addition, when backing and ramming, the vessel is essentially stationary, so the ensonified area is limited for a short period (on the order of minutes to tens of minutes) to the immediate vicinity of the boat until the ship breaks free and once again makes headway.

Although the report by Roth and Schmidt has not yet been reviewed externally nor peer-reviewed for publication, the SPL results reported are consistent with previous studies (Thiele, 1981, 1988; LGL and Greeneridge, 1986, Richardson and others, 1995).

NMFS (2005) indicates the existing threshold for Level B harassment for continuous sounds is a received sound level of 120 dB SPL. Therefore, we estimated the 120 dB received sound level radius around the *Healy* while icebreaking. Using a spherical spreading model, a source level of 185 dB decays to 120 dB in about 1750 m. This model is corroborated by Roth and Schmidt (2010). Therefore, as the ship travels through the ice, a swath 3500 m wide would be subject to sound levels ≥120 dB. This results in the potential exposure of 11,802 $km^2$ to sounds ≥120 dB from icebreaking.

Based on the operational plans and marine mammal densities described above, the estimates of marine mammals potentially exposed to sounds≥120 dB during the maximum estimation of icebreaking outside U.S. waters, i.e. 3372 km, are presented in Table Add-4. For the common species, the requested numbers are calculated as described above and based on the average densities from the data reported in the different studies mentioned above. For less common species, estimates were set to minimal values to allow for chance encounters.

TABLE ADD-4. Estimates of the numbers of marine mammals potentially exposed to received sound levels ≥120 dB during USGS's proposed seismic program while breaking ice outside of U.S. waters. Species in italics are listed under the U.S. ESA as endangered.

| | Number of Exposures to Sound Levels ≥120 dB | |
|---|---|---|
| | Polar Pack | |
| **Species** | **Average** | **Maximum** |
| **Odontocetes** | | |
| **Monodontidae** | | |
| Beluga | 42 | 84 |
| Narwhal | 0 | 1 |
| **Delphinidae** | | |
| Killer whale | 0 | 1 |
| **Phocoenidae** | | |
| Harbor porpoise | 0 | 1 |
| **Mysticetes** | | |
| *Bowhead whale* | 7 | 1 |
| Gray whale | 0 | 1 |
| Minke whale | 0 | 1 |
| *Fin whale* | 0 | 1 |
| *Humpback whale* | 0 | 0 |
| **Total Cetaceans** | 49 | 92 |
| **Pinnipeds** | | |
| Bearded seal | 15 | 60 |
| Spotted seal | 0 | 0 |
| Ringed seal | 296 | 1185 |
| **Total Pinnipeds** | 311 | 1245 |

## IX. ANTICIPATED IMPACT ON HABITAT

The *Healy* is designed for continuous passage at 3 kt through ice 1.4 m thick. During this project the *Healy* will typically encounter first- or second-year ice while avoiding thicker ice floes, particularly large intact multi-year ice, whenever possible. In addition, the icebreaker will follow leads when possible while following the survey route. As the icebreaker passes through the ice, the ship causes the ice to part and travel alongside the hull. This ice typically returns to fill the wake as the ship passes. The effects are transitory, i.e. hours at most, and localized, i.e. constrained to a relatively narrow swath perhaps 10 m to each side of the vessel (Fig. Add-1).

*Healy*'s maximum beam is 25 m (Appendix D of the original application). Applying the maximum estimated amount of icebreaking, i.e. 3372 km, to the corridor opened by the ship, we anticipate that a maximum of ~152 $km^2$ of ice may be disturbed. This encompasses an insignificant amount (<0.005%) of the total Arctic ice extent in Aug and Sep of 2008 and 2009 which ranged from 3.24 million $km^2$ to 4.1 million $km^2$.

FIGURE ADD-1. Icebreakers *Healy* and *Louis S. St-Laurent* transiting 10/10 ice pack on 2 September 2009, showing minimal disturbance to the ice pack abeam of the ship's path, small jog to avoid larger ice body, and closing of the pack ice in the ship wake.

## X. ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF HABITAT ON MARINE MAMMALS

Icebreaking will create temporary leads in the ice and could possibly destroy unoccupied seal lairs. Seal pups are born in the spring, therefore, pupping and nursing will have concluded and the lairs will be vacated at the time of the proposed survey. Breaking ice may damage seal breathing holes and will also reduce the haulout area in the immediate vicinity of the ship's track.

Icebreaking along a maximum of 3372 km of trackline will alter local ice conditions in the immediate vicinity of the vessel. This has the potential to temporarily lead to a reduction of suitable seal haul-out habitat. However the dynamic sea-ice environment requires that seals be able to adapt to changes in sea, ice, and snow conditions, and they therefore create new breathing holes and lairs throughout winter and spring (Hammill and Smith 1989). In addition, seals often use open leads and cracks in the ice to surface and breathe (Smith and Stirling 1975). Disturbance to the ice will occur in a

very small area (<0.005%) relative to the Arctic icepack and no significant impact on marine mammals is anticipated by icebreaking during the proposed project.

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