

TITLE: Arctic expedition cruise tourism and citizen science: a valuable contribution to Arctic observing capacity

AUTHORS: Audrey R. Taylor¹, Lauren Farmer², Annette Bombosch²

¹Taylor: Department of Geography & Environmental Studies, University of Alaska Anchorage, 3211 Providence Drive, Anchorage, AK 99508, USA, artaylor@alaska.edu

²Farmer and Bombosch: The Polar Citizen Science Collective, info.polarcollective@gmail.com

THEME:

Sub-Theme 1: Design, Optimization and Implementation of the Observing System

Much interest in the last decade has been generated by the concept of community-based observing and monitoring (CBOM), activities engaging the public in the scientific process which have been recognized as a way to counteract a lack of environmental data and monitoring initiatives by professional scientists and government agencies (Conrad and Hilchey, 2011). Alessa et al. (2015) created a “typology” of community-based observing and monitoring, which placed CBOM projects along a spectrum of attributes such as community involvement in program design, structure in data intake, presence of quality assurance methods, and diversity of individuals participating. In this typology, **citizen science** projects tend to be initiated and maintained by professional scientists and engage a relatively homogenous group of participants, whereas **community-based observing networks** tend to be driven by community leaders and engage a broader segment of the local population (Alessa et al., 2015). While it is critical that CBOM projects in general are recognized as having the potential to contribute to Arctic observing systems, to date more attention has been given to the development of Arctic community-based observing networks wherein local observers collect on-the-ground information during the course of their daily activities (e.g., the Alaska-based Local Environmental Observer network [LEO; Mosites et al., 2018] and the Greenland-based PISUNA project [Danielsen et al., 2014]). Murray et al. (2013) noted that other individuals who have short-term opportunities to collect information of relevance to Arctic observing and research needs may serve as citizen scientists. Members of northern fishing fleets, dog mushers, seasonal industrial workers, and tourists are a few examples of “communities” Murray et al. (2013) gave that can be engaged in Arctic observing; we will focus on the last in this statement.

In recent years, global changes in the polar environment have changed the focus for marketing of tourism, and terms like “last chance to visit” have been used to draw in new tourist demographics (Lemlin et al., 2010), some of which are highly adventure-oriented and interested in educational experiences in the landscapes they visit. Reduced sea ice extent and thereby increased accessibility into polar areas has opened up new routes for cruise ships, resulting in changes in cruise travel patterns (Lück et al., 2010). For these reasons and others, Arctic expedition cruising (typically done on smaller ships – 100-200 passengers compared with upwards of 3000, and with more adventurous itineraries) has increased significantly. The Association of Arctic Expedition Cruise Operators (AECO) keeps an overview of the number of passengers carried annually by AECO members; by 2016, expedition cruise passengers constituted a quarter of total cruise passenger numbers in the Arctic, and the number of passengers carried by AECO member ships in AECO’s core areas (Svalbard, Jan Mayen, Greenland, Arctic Canada, Russian Arctic National Park, and Iceland) increased from 13,480 passengers in 2008 to 32,356 passengers in 2019 (AECO, *unpubl. data*).

AECO strongly encourages its members to implement measures such as onboard lectures, participation in beach cleanups, and citizen science projects to educate passengers and invite them to reflect about environmental issues in the Arctic. Recently, a group of polar expedition guides, scientists, and other industry experts formed the Polar Citizen Science Collective (<http://www.polarcollective.org>), which, with the support of AECO, works closely with scientists to promote high quality ship-based citizen science projects on board expedition vessels. Examples of such projects include Happywhale (<https://happywhale.com>), a platform for gathering marine mammal photos from citizen scientists aboard cruise ships worldwide; NASA's GLOBE Observer, which encourages observations of cloud cover timed to satellite overpasses, FjordPhyto, a Scripps Institution of Oceanography project that gathers samples of phytoplankton in coastal fjords (<https://scripps.ucsd.edu/programs/fjordphyto/>), and Ice Watch, a program for standardizing sea ice observations from both tourism and research vessels.

Based on our experiences as polar researchers and expedition guides, our viewpoint is that citizen science on board expedition cruise vessels should be considered as an important component of an integrated global Arctic Observing System (AOS). Expedition operators often repeat the same cruise itineraries multiple times within seasons and across years, and expedition passengers, led by experienced guides following scientifically rigorous study designs, can collect repeated measurements of environmental phenomena in the hard-to-reach areas of the Arctic Ocean. For example, Poseidon Expeditions' citizen science team has collected the only repeat set of sea ice observations from Franz Josef Land to the North Pole for the past four summers (Farmer et al., 2016); this could be invaluable data for sea ice modeling and prediction efforts. The Arctic research community needs to be made more aware of the opportunity for scientific data collection presented by onboard citizen science programs, and scientists themselves should be encouraged to design study protocols that are appropriate for expedition-based citizen science methodologies. This could be accomplished via novel funding programs offered by national or international organizations like the United States' National Science Foundation or the Arctic Council working groups. Once shown to be effective, such expedition cruise vessel-based citizen science programs should be included in designs for a global AOS (de la Barre et al., 2016). In addition, increased emphasis on the inclusion of tourist-collected data could provide Arctic expedition cruise passengers a compelling reason to participate in on-board citizen science and even support continued Arctic research and conservation (Powell et al., 2008).

References

- Alessa, L., Kliskey, A., Pulsifer, P., Griffith, D., Williams, P., Druckenmiller, M., McCann, H., Myers, B., Beaujean, G., and Jackson, L. 2015. Best practices for community-based observing: a national workshop report. 5-6 October 2015, Seattle, WA. Accessed 15 November 2019 at: https://www.arcticobservingsummit.org/sites/default/files/Alessa%20et%20al%20-%20CBONReport_DR_AFT%20FINAL-updated-2016-03-07.pdf
- Conrad, C. C., and Hilchey, K. G. 2011. A review of citizen science and community-based environmental monitoring: issues and opportunities. *Environmental Monitoring and Assessment* 176:273-291.
- Danielsen, F., Topp-Jørgensen, E., Levermann, N., Løvstrøm, P., Schiøtz, M., Enghoff, M., and Jakobsen, P. 2014. Counting what counts: using local knowledge to improve Arctic resource management. *Polar Geography* 37:69-91. doi: 10.1080/1088937X.2014.890960.

de la Barre, S., Maher, P., Dawson, J., Hillmer-Pegram, K., Huijbens, E., Lamers, M., Liggett, D., Müller, D., Pashkevish, A., and Stewart, E. 2016. Tourism and Arctic Observation Systems: exploring the relationships. *Polar Research* 35: 24980, doi: 10.3402/polar.v35.24980.

Farmer, L., Cowan, A., Hutchings, J. K., and Perovich, D. 2016. Citizen scientists train a thousand eyes on the North Pole. *Eos* 97: <https://doi.org/10.1029/2016EO054989>.

Lemelin, H., Dawson, J., Stewart, E. J., Maher, P., and Lück, M. 2010. Last-chance tourism: The boom, doom, and gloom of visiting vanishing destinations. *Current Issues in Tourism* 13:477–493, doi: 10.1080/13683500903406367.

Lück, M., Maher, P. T., and Stewart, E. J. 2010. Setting the scene: Polar cruise tourism in the 21st century. In Lück, M., Maher, P. T. and Stewart, E. J., eds. *Cruise tourism in the polar regions. Promoting environmental and social sustainability?*, (pp. 1-7). London: Routledge.

Mosites, E., Lujan, E., Brook, M., Brubaker, M., Roehl, D., Tcheripanoff, M., and Hennessy, T. 2018. Environmental observation, social media, and One Health action: a description of the Local Environmental Observer (LEO) Network. *One Health* 6:29-33.

Murray, M. S., Loring, P. A., Ferren, H., and Fedderer, R. 2013. Citizen science and Arctic observing: using the internet and simple technologies to improve understanding of Arctic ecosystem change. Arctic Observing Summit 2013 Short Statement, <https://Arcticobservingsummit.org/short-statements>.

Powell, R. B., Kellert, S. R., and Ham, S. H. 2008. Antarctic tourists: ambassadors or consumers? *Polar Record* 44:233-241; doi 10.1017/S0032247408007456