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Commentary

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Importance of international collaboration in the study of cetaceans: experiences of the Institute of Cetacean Research

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The Institute of Cetacean Research (ICR) is an institute focused on the studies of cetaceans. This includes the baleen whale species, which have been the target of several studies by the ICR. Baleen whales are particularly difficult to study, because they are migratory animals and their habitat is mainly oceanic. They move seasonally between low latitude breeding areas and high latitude feeding areas. International research collaboration on cetaceans, particularly on baleen whales, is relevant and important for several reasons. In this article, these are explained and illustrated by use of case studies at the ICR.

International research collaboration facilitates the access to samples and information from wider areas

The study on some research topics of cetaceans requires samples and information not only from wider areas within an oceanic basin, but also globally. For example, the studies on taxonomy, stock structure, abundance and the impact of cetaceans on the marine ecosystem fall into this category. The ICR has succeeded in addressing some important scientific questions related to such topics, especially regarding baleen whales. This has been achieved often through international research collaborations.

The taxonomy of some baleen whale species is yet to be settled, and the elucidation of their taxonomical status requires studies based on samples collected worldwide. The ICR has collaborated with international colleagues in studies on the taxonomy of blue, right, Bryde's and minke whales. Here, I explain briefly the collaborative study on minke whale taxonomy. Two species of the minke whale are recognized, the Antarctic minke whale *(Balaenoptera bonaerensis)*, which is restricted to the Southern Hemisphere, and the common minke whale (*B. acutorostrata)*, which is distributed globally. Furthermore, three sub-species of the common minke whale are recognized, one in the North Pacific (*B. a. scammoni)*, one in the North Atlantic *(B. a. acutorostrata)*, and one in the Southern Hemisphere (dwarf or diminutive minke whale). The latter is an un-named sub-species of the common minke whale. In order to elucidate the taxonomical status of the dwarf minke whale, international research collaboration was carried out between ICR scientists and scientists from regions where dwarf minke whales are distributed in the Southern Hemisphere, specifically scientists from several research institutes in Chile and Brazil. The last published work based on mitochondrial DNA (mtDNA) and microsatellite DNA (msDNA) indicated significant genetic differences between western South Pacific and western South Atlantic dwarf minke whales, suggesting that the taxonomical status of common minke whales in the Southern Hemisphere should be revised (Milmann *et al.*, 2021).

Within an oceanic basin, a species of baleen whales is composed of stocks, which are demographically independent units. The identification of such units, through genetic and non-genetic analyses, is very important, because conservation and management policies should be based on these units. International collaboration by ICR has been important in investigating the number and distribution of stocks in some baleen whale species distributed through the entire North Pacific Ocean. In the case of North Pacific right whales, genetic analyses based on mtDNA were conducted to investigate the stock structure of this species in this oceanic basin. The analyses were facilitated by the collaboration between Japanese scientists who contributed genetic data from the western sector of the North Pacific Ocean, and US scientists who contributed genetic data from the eastern sector. Results of the study confirmed that at least two stocks occur in the North Pacific Ocean, one in the western side and the other in the eastern side (Pastene *et al.*, in review). This is key information for developing conservation policies for this depleted species.

Other examples include the genetic analyses on stock structure of sei and Bryde's whales in the North Pacific Ocean, carried out with genetic samples from different sources. Genetic samples from the western North Pacific Ocean were collected by ICR scientists during the former

whale research programs conducted under the IWC special permit (JARPN, JARPNII and NEWREP-NP), and biopsy samples were also obtained during Japanese dedicated sighting surveys. Genetic samples from the central and eastern North Pacific Ocean were mainly biopsy samples collected during dedicated sighting surveys of the International Whaling Commission Scientific Committee (IWC SC) POWER (Pacific Ocean Whale and Ecosystem Research). This is a collaborative research program between Japan and the IWC. Genetic analyses based on mtDNA and msDNA suggested two stocks of Bryde's whales in the central-western North Pacific Ocean with spatially overlapping distribution, and one stock of sei whales in the whole of the North Pacific Ocean. International research collaboration enabled large areas in the North Pacific Ocean to be covered, and the results of the genetic analyses on the stock structure of these two species were important for the work on assessment and management carried out by the IWC SC. The analyses presented in IWC (2018) is one example of this kind of research.

Abundance estimates of sei and Bryde's whales as well of other species in large areas of the North Pacific Ocean have also benefited from the Japan-IWC international research collaboration through the POWER surveys (see IWC, 2020).

The research of the impact of baleen whales on the marine ecosystem also requires samples and information from wider areas within an oceanic basin. Once again, international collaboration plays an important role. Qualitative and quantitative analyses of prey consumption by whales are commonly used to investigate the impact of whales on the ecosystem. Estimates of prey consumption by marine mammals in the North Pacific Marine Science Organization (PICES) region, which cover the entire North Pacific Ocean, were made in collaboration between the ICR and scientists from research organizations in Canada (Tamura *et al.*, 2019). This collaborative research was an important contribution to the 5-year PICES project titled 'Climate and Trophic Ecology of Marine Birds and Mammals.'

International research collaboration facilitates the access to, and interchange of, field, laboratory and analytical techniques

Research groups from different institutes have different levels of expertise on field, laboratory and analytical techniques used for different scientific purposes. In science, the development and improvement of such techniques progress rapidly. In such an environment, it is clear that collaboration among institutes will facilitate access, interchange and use of new techniques among collaborating laboratories.

It should be noted that access to, and interchange of, new field, laboratory and analytical techniques are not restricted to cetaceans nor solely to international collaboration. Collaboration among research institutes within one country, irrespective of target species, could also contribute in achieving the same purpose.

Below are some cases of ICR's international collaborations that have resulted in the interchange of new techniques.

New techniques acquired by ICR as a result of international research collaboration

Survey design and analytical techniques for abundance estimates

Abundance estimates of whale species is essential for defining policies on conservation and management. Given the importance of this topic, and to ensure the design and implementation of sighting surveys as well as analyses of the data are in line with the guidelines adopted by the IWC SC, scientists of ICR have received technical and scientific advice from experts of several international research institutes and universities. These have included organizations in South Africa and Scotland, and also the IWC POWER program (IWC, 2020).

Kinship analysis

This technique was acquired by ICR following collaboration with a university in Germany regarding the North Pacific common minke whale stock structure. Kinship information based on the analyses of genetic data is very important in addressing questions on ecology, stock structure and abundance estimates.

Ecological markers

The occurrence of external and internal parasites in whales can be used as ecological markers to resolve, among others, questions on stock structure. ICR scientists have benefited from a recent collaboration with scientists from a university in Spain to investigate the use of parasites as ecological markers for Antarctic minke whales. As a result, techniques for the identification and analyses of parasites were acquired by ICR.

Satellite tracking

Satellite tracking of whales is a useful tool to study movement, stock structure and behavior of whales. ICR scientists are using this technique to study such aspects in whales from both the Antarctic and North Pacific Oceans.

The technique used by ICR scientists has improved considerably, thanks to the international collaboration with experts from an institute in Norway. More recently, Japan and the North Atlantic Marine Mammal Commission (NAMMCO) commenced a collaborative project to develop miniature tags (MINTAG project) to be used on fast swimming whale species in the North Atlantic, the North Pacific and other oceans.

Krill surveys

ICR scientists have collaborated with specialists from the Convention for the Conservation of Marine Living Resources in the Antarctic (CCAMLR) regarding the design and implementation of krill surveys using dedicated sighting vessels for cetaceans as a platform. The advice from visiting CCAMLR specialists resulted in an improved data collection method in estimating the abundance and distribution of krill.

Statistical models

ICR scientists have benefited from an international collaboration with Norwegian scientists in developing and applying statistical models to study yearly trends of biological characteristics of whales. In particular, these statistical models were applied in a study on the trend of blubber thickness and stomach-content weight in Antarctic minke whales, in order to assess yearly change in body conditions of this species. See Cunen *et al.* (2021) for the latest application of the statistical models that address this research topic.

Technical assistance of ICR to scientists from foreign countries

ICR scientists have participated in programs of collaboration that included the transfer of new survey, laboratory and analytical techniques to colleagues from foreign countries.

Some examples include the collaborative programs with scientists from Caribbean and western African countries. To learn sighting surveys techniques for the purposes of abundance estimation and genetic analyses on stock structure, scientists from St. Lucia and St. Vincent and the Grenadines in the Caribbean, as well as from the Republic of Guinea and other countries from western Africa have visited ICR. At the same time, some ICR scientists have visited those countries to participate in field works and hold lectures on relevant research topics.

Other examples include research collaborations with Brazilian and Mexican scientists on population genetic analyses pertaining to large whales. As a result of such collaboration, foreign colleagues increased their knowledge on genetic techniques available at the ICR (laboratory and analytical), which in turn, allowed them to apply such techniques in their respective countries.

Final remarks

Based on just some of ICR's experiences outlined above, it is clear that international collaboration is important for the studies of cetaceans, including the difficult group of baleen whales. International research collaboration on topics such as stock structure, abundance, and impact of cetacean on the ecosystem is important because such collaboration enables coverage of wider areas of the distribution of species and stocks. It is also important for access to, and interchange of, laboratory, field and analytical techniques among research institutes from different regions and countries.

Despite the advances and benefits of internet communications, research activities of many research organizations in the world are still not well known to many people, and even to a large part of the scientific community. The ICR is not an exception in this respect. International research collaboration, with interchange of scientists between laboratories on specific scientific projects, will facilitate the mutual understanding of objectives and activities of the research institutes involved.

Further, international research collaboration will allow the interchange of ideas and modes of working among scientists from different countries. This should facilitate the understanding of the different cultures involved. Ignoring such differences may result in misunderstandings or miscommunication during scientific debates among scientists from different countries.

Responding to and appropriately addressing scientific questions on baleen whales are indispensable for their conservation and management. International collaboration contributes greatly to this end, as evidenced by the results of several cases at the ICR. Therefore, the ICR should continue to seek and engage in international collaboration on research topics relevant for the conservation and management of cetaceans.

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