

CIBJO
CONGRESS
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SPECIAL REPORT
PEARL COMMISSION



Environmental costs and benefits assume increasingly prominent profile for pearl producers

By Kenneth Scarratt, President
CIBJO Pearl Commission

It is with some sadness that we open this report reflecting back upon the enormous contributions made to the industry overall by Roland Naftule, who we lost on April 1 of this year. Under his leadership of CIBJO's Sector A, the Pearl Commission, as well as the others, grew in strength and stature, and we were able

to meet our goals and expectations like we have never done before.

Just to say "thank you" seems pitifully small but what comes from behind those simple words is a genuine love and respect towards a great human being, who sadly is no longer with us.

Thank you Roland for guiding and advising us so well throughout your many decades of industry leadership.



Kenneth Scarratt, President of the CIBJO Pearl Commission.

Still a 'special' year

To think of this past year as special might not be considered an understatement given

the previous few pandemic years. Pearls, both natural and cultured, not only continue to be a staple of the jewellery industry globally, but over the past year they appear to have flourished within their own distinctive markets.

One study, places the overall market size for 2023 at \$10.49 billion, a growth of \$2 billion over 2022, but it further forecasts an increasing market size to \$24.37 billion by 2030, with the Asia Pacific region being the fastest growing market (<https://www.custommarketinsights.com/report/pearl-jewelry-market/>).

Although parts of this report reveal a lack of product knowledge, particularly in the area of "significant threats," it appears that the forecasts have been calculated from several globally known sources. Naturally, forecasts are just that —forecasts. Reality will check in as time passes.

As it may be seen by the Paspaley projections later in this report, these predictions certainly make a degree of sense when the production levels of white South Sea cultured pearls and their consequential values are taken into account. We can also see a clear upward trend between 2020 and 2023 from the figures produced from the Japanese Ministry of Agriculture, Forestry and Fisheries, and the Japanese Trade Statistics, which are set out later within this report.

In addition, Chunhui Zhou, GIA's Senior



Peter Bracher, Vice President of the CIBJO Pearl Commission.



Shigeru Akamatsu, Vice President of the CIBJO Pearl Commission.



Jacques Christophe Branellec, Vice President of the CIBJO Pearl Commission.

Manager of Pearl Identification and a CIBJO Pearl Commission member, in reporting his observations of the latest Hong Kong show, states “High quality cultured pearls are in shortage and the prices have increased significantly.”

Furthermore, he notes, “it seems this, and more interest in natural pearls from the trade, together has lead towards a greater volume of work for GIA’s pearl testing facilities in New York and globally.”

Adding a sustainability section to the Blue Book

As as agreed during the 2021 Virtual CIBJO Congress, a special committee, as well as the Steering Committee of the Pearl Commission, have been working on a pearl sustainability” addition to the CIBJO Pearl Guide. This section now awaits discussion and approval during the upcoming CIBJO Congress in Jaipur and is presently titled “Social, Environmental and Economic Impact of Natural and Cultured Pearls.”

Thus far, during the editing and evaluation process that has taken place over the past year, the additional text has met with collective support and the commission is looking forward to the final discussions during congress.

Pierre Fallourd, who leads the Pearl Commission’s sustainability special committee and is the driving force behind leveraging value on provenance for pearls, a collaborative project started in the midst of the COVID pandemic, notes that the recent adoption of European Sustainability Reporting Standards (ESRS) for large and listed organisations doing business in and with Europe (https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_4043) will significantly accelerate the transition from voluntary corporate social responsibility (CSR) claims to more science-based environmental, social and governance (ESG) reporting.

Under the legislation, companies will have to report both on their impact on people and the environment, and on how social and environmental issues create financial risk and opportunities. This will be enforced as early as 2025 for the largest companies by 2029 for the others.

Responsibility beyond productivity gains

Molluscs are indicator species. Their growth and survival rely on the health of waterways. The pearls produced all reflect the journey of the oysters and mussels they are harvested from.

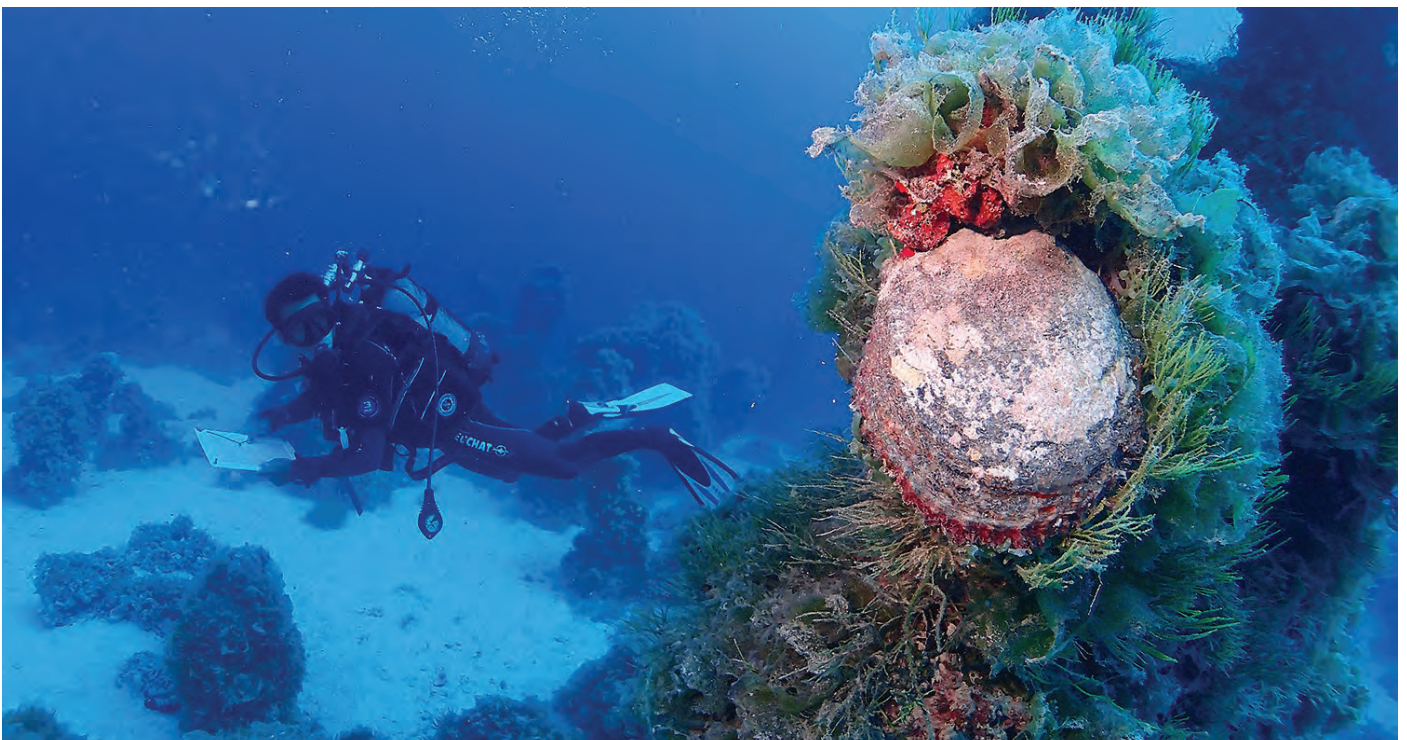


Photo courtesy of the Department of Marine Resources, French Polynesia.

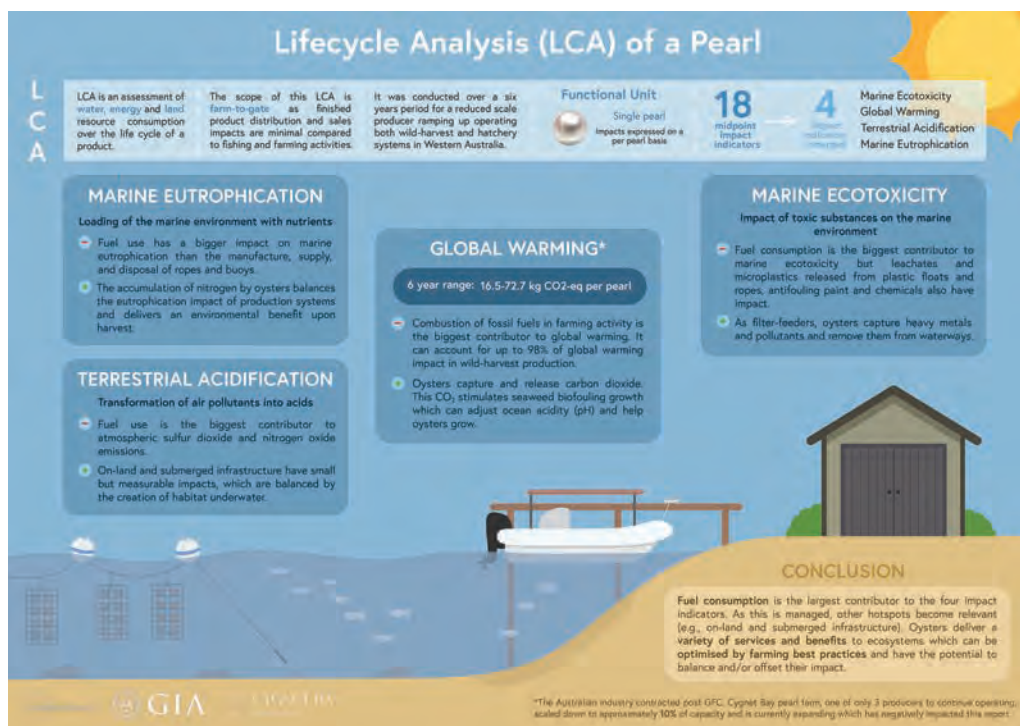
The formation of nacre can happen naturally or be triggered by humans, in which case, the skills, care and sometimes inspiration of pearl farmers greatly influence the quality of each gem harvested. But responsible players have gone beyond chasing productivity gains and mitigating risks to actively manage their social and environmental impact.

- Australia’s wild pearl oyster quota system is certified by the Marine Stewardship Council (MSC) and will include hatchery-born oysters.
- The Philippines took the path of promoting pearl farms as marine protected areas to ensure habitat is preserved.
- Indonesia is engaged in community development via education and conservation programs using pearl farms as logistical hubs.
- French Polynesia’s “Charte des bonnes pratiques” encourages a more efficient use of resources.
- Fiji is committed to the principles of blue economy.
- Japan recently launched a circular concept where unused parts of oyster meat are converted to fertiliser.
- China opted for a drastic reduction of production volume to focus on freshwater pearl quality as well as innovative closed-cycle aquaculture systems to clean urban waterways.

of restorative (or should we say regenerative) aquaculture, and running collaborative projects with industry using an in-house ESG assessment tool.

“Pearling was a great opportunity to test our framework on a global industry with diverse challenges” said Heidi Alleway of TNC.

GIA funded the first ever pearl Life Cycle and ESG assessments to build Pearlpoints, an online open-source impact self-assessment tool for pearls. “This initiative is complementary to GIA’s education and pearl services and will help project them into the future,” said Tom Moses, GIA Executive Vice President and Chief Laboratory and Research Officer. “Our goal is to empower farmers by providing them with the necessary frameworks and digitized systems to take control of their sustainability efforts.”



GIA’s infogram showing the environmental impact of a pearl over its lifetime cycle.

Researching the impacts of pearling

The Gemological institute of America and the Nature Conservancy (TNC) teamed up to better understand the social and environmental impacts of pearling, and have added sustainability data to pearl origin tracking.

TNC also has been promoting the principles

Pierre describes the new initiative “Pearlpoints” as a tool that does not replace an actual Life Cycle Analysis or ESG assessment but provides detailed information about emissions, nitrogen capture, restorative aquaculture, and indications on data readiness.

The first version focuses on saltwater cultured

pearls, but the same approach can be applied to freshwater and natural pearls.

“By binding sustainability credentials and traceability together, we create a pathway for responsible players of all size and origin to understand and manage their impacts and doing so change the way pearls are appreciated” states Pierre.

The threat of microplastics on sustainability

Over several years, an important conversational topic in the world of pearl culturing has been the reported pollution issues linked to freshwater cultured pearl farming in China. Deliberations within the Pearl Commissions Special Committee on pearl sustainability have shown that, while water pollution concerns in China were indeed valid, great strides have been taken to mitigate them with several pain points addressed with significant progress.

While much is known concerning the wonderful water filtering capabilities of individual oyster species in both freshwater and saltwater environments, which are mentioned in many reports, the debate is on-going relative to the accuracy of the assumptions made.

On the pollution of natural pearling beds an interesting 2020 report by Hammadi et.al., on the pollution in the oyster bed ecosystems of the northern shores of the United Arab Emirates, revealed the presence of microplastics in sediments and oysters collected from the these UAE shores.

Placing this in context, the report states that “tourism, fishing, shipping, and other marine-

based activities contribute to the release of pollution to the marine environment. The sites chosen for this [wider] study all tend to host such activities, which would contribute to the abundance of microplastics in those areas.”

“The abundance of microplastics in the sediments and oysters in this study, in the Arabian and Andaman Sea, Southern Iran, the Argentinean estuaries, East China sea, China, and India was higher than the microplastics abundance measured in the sediments of New South Wales, Singapore, and Northern China,” the report added, noting that the fibrous microplastics were the most abundant in this study of the oyster beds in the UAE, which is consistent with those of the other studies as well.

One of the most dominant sources of fibers in marine environments is fishing gears. Since the areas studied host significant fishing and shipping activities, these would likely contribute to the larger number of fibers found in the areas, the study said.

Another interesting 2020 paper (Zaiming Han et.al.) focuses more on microplastics in pearl culturing areas. The authors state here that their results provide important evidence that microplastics exposure may impact the appearance of biominerals and the expression of biomineralization-related genes, posing a new potential threat to aquatic organisms. These suggestions are echoed by Gardon et.al., in their 2024 preprinted preliminary report “Pearl farming micro-nanoplastics affect both oyster and pearl quality.”



Photo: Naja Bertolt Jensen on Unsplash.

COUNTRY REPORTS



BAHRAIN

The following information is based on data made available to CIBJO Pearl Commission Member Noora Jamsheer, CEO of the Bahrain Institute for Pearls and Gemstones (DANAT).

Pandemic's impact on pearl retailers

The pearl industry in Bahrain was impacted as result of COVID 19 crisis. While businesses did

not have to completely halt operations, access to retail shops was restricted at various times.

As was the case elsewhere the world, many retailers moved business online. This conversion allowed them to reach a wider consumer base, which led to an increase in demand for their products, including natural pearls.

When retailers were allowed to operate freely again, demand for pearls continued to flourish throughout 2021 and 2022. An indication of this was that during during this period pearls submitted for testing at DANAT doubled in volume.

Pearl diving

In early 2020, the Department of Fisheries in Bahrain halted the issuance of pearl diving licenses to pearl divers in Bahrain. The halt which coincided with the pandemic, aimed to ensure the natural pearl beds were not depleted. This prompted the Department of Fisheries, Supreme Council for Environment and DANAT to collaborate on a research project to study the state of the natural pearl beds around Bahrain.

By 2022, the Department of Fisheries resumed the issuance of pearl diving licenses and today the number of authorized pearl divers in Bahrain stand at approximately 1,300.

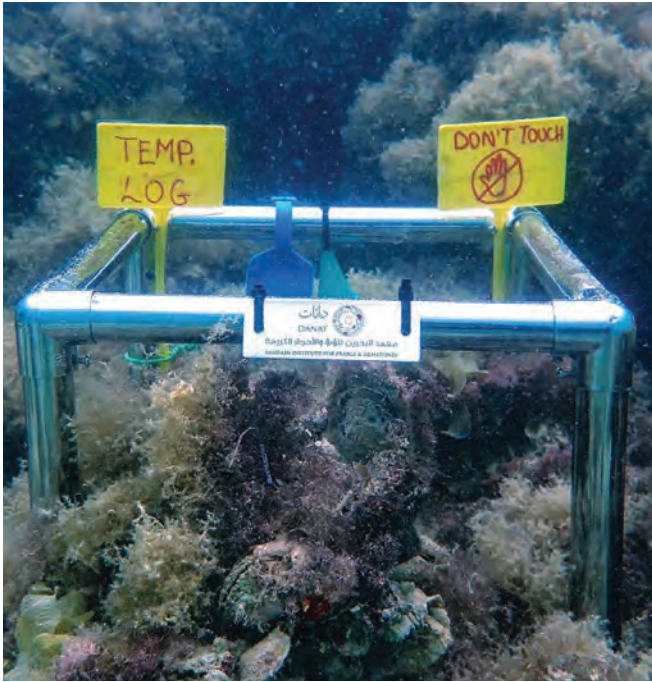


Diving for pearls off Bahrain. Photo courtesy of DANAT.

Research into state of pearl oyster beds

Following the Government of Bahrain's launch of the National Plan to Revive the Pearl Sector in 2016, the Directorate of Fisheries, the Supreme Council for Environment and DANAT engaged in a research project to study the status of the pearl beds around Bahrain. It commenced in 2021.

The study aimed to assess the status of the



A temperature logging experiment being conducted in the water off Bahrain, by DANAT. Photo courtesy of DANAT.

pearl oyster beds and conduct a temporal comparison of selected areas in Bahrain. The project objectives were to assess the community structure of the pearl oyster beds at selected sites; to assess the abundance of pearl oysters through the estimation of pearl oyster densities; to assess the population size, structure and distribution; and to assess changes in the pearl yields

The temporal comparison would be based on data collected in the period during phases 1 and 2 of the project which extended from 2020 to 2022, against the data collected from a similar study in 2012.

Based on the findings of phase 1, the number of oysters increased in 2021 in comparison to 2012, and population size structure shifted from older to younger generation. But no significant changes

were observed in the incidences of pearls.

DANAT aims to continue the research project in collaboration with the Supreme Council for Environment and Department of Fisheries.

National plan to revive the pearl sector

The pearl industry in Bahrain continues to be driven by the government of Bahrain's commitment to revive the pearl sector. It consists of four objectives that are allocated to various governmental entities with the aim of (1) reviving the global natural pearl market (2) preserving and sustaining the state of the pearl beds, (3) reviving the history and culture of the pearl industry, and (4) establishing market systems to modernize the trade in natural pearls.

As a result, and in line with the fourth objective of the national plan, the Rapaport Group in 2023 launched the first natural pearl tender aimed at increasing natural pearl availability to wholesalers, designers and retailers. The tender's objective is to establish a consistent supply of natural pearls to meet international demand for natural pearls. DANAT's revised natural pearl grading system was used to sort the pearls.

The natural pearl tender will take place twice a year will cater exclusively for businesses. As such, Bahrain continues to be the only country in the world that only trades in natural pearls.



The DANAT-hosted pearl tender by Rapaport in Bahrain.



JAPAN

The following information on the Japanese market is contributed by CIBJO Pearl Commission member Ryuichiro Machizawa.

Background and market trends

The Japanese pearl industry in the 20th Century began with the successful cultivation of hemispherical cultured pearls by Kokichi Mikimoto in 1893 and the invention of spherical cultured pearls by Tokichi Nishikawa, Kokichi Mikimoto and Tatsuhei Mise in the early 20th century.

After World War II, supported by strong demand for Akoya cultured pearls mainly in the U.S.

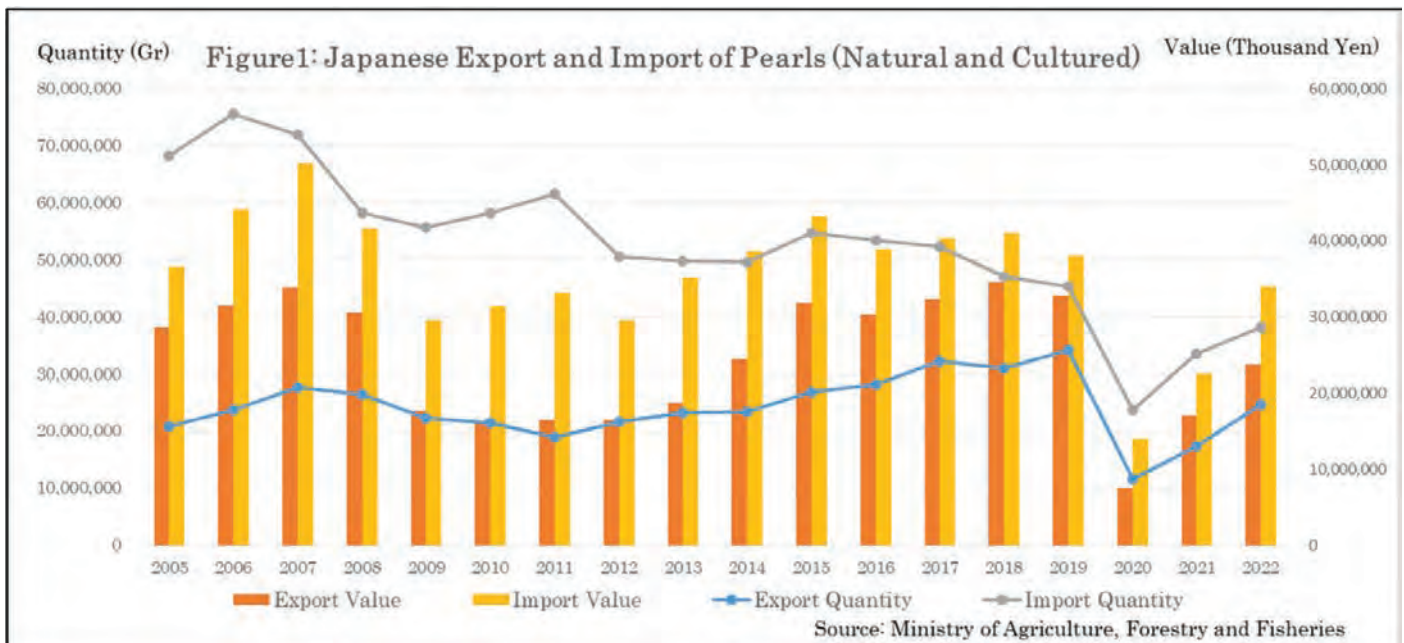
market, Japan established a monopolistic supply system for the world cultured pearl market, and Kobe became the hub of international trade.

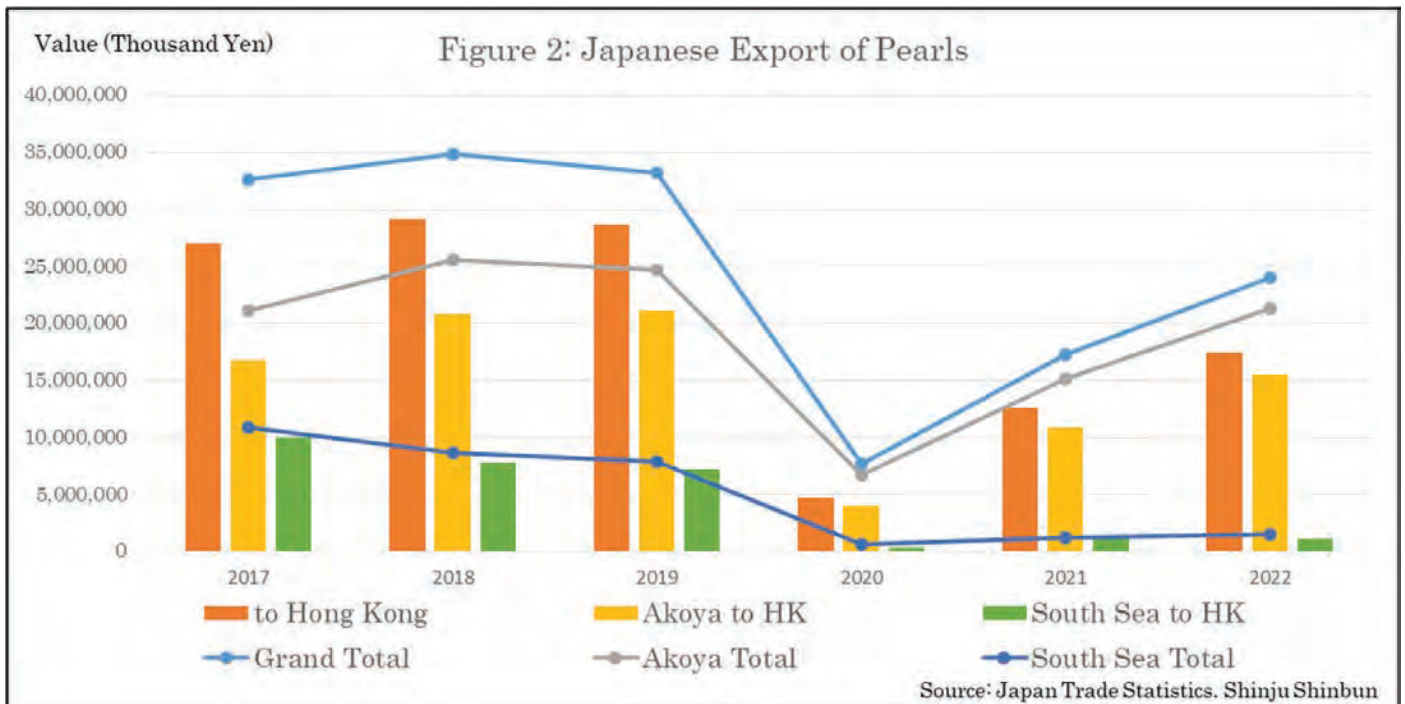
However, with the abolition of the Pearl Culture Industry Law and spread of pearl culture worldwide, the ratio of export and import was reversed in 1999 in terms of quantity and in 2003 in terms of value. Japan changed its position from an exporter to an importer of pearls and Hong Kong has begun to show its presence as the international hub.

In the first decade of the 21st century, imports continued to exceed exports greatly, but this trend began to change around 2013. The excess of imports by weight, which was 51 tons in 2006, decreased to 11 tons in 2019, and the excess of imports by value, which was 16.4 billion yen in 2007, decreased to 5.1 billion in 2019.

Hong Kong has been the largest customer of Japanese pearl exports which has begun to show signs of recovery since 2013. The export value of pearls from Japan to Hong Kong began to rise around 2010, and since 2013, Hong Kong has been far ahead of the second place U.S.

As an exporter by value into Hong Kong, Japan gave up its long-held number one position to Australia in 2003, and was overtaken by China in the following year to fall into third place. For a while, these three countries and Tahiti, which was ranked fourth, dominated the top 4.





But from 2014, Japan the number 1 spot by a large margin.

According to the recent breakdown of exports from Japan to Hong Kong, Akoya pearls accounted for more than 80 percent by quantity and about 70 percent by value until 2019. But after 2020, white and black South Sea pearls, which had accounted for more than 20 percent by value until then, accounted for less than 10 percent by value, and Akoya pearls in 2022 accounted for 16 tons by quantity (95.5 percent) and 15.5 billion yen by value (88.8 percent).

The total value of exports from Japan to Hong Kong in 2022 was 17.4 billion yen, which was equivalent to the value in 2008 (16.8 billion yen), just before the global financial crisis, and to the value in 2014 (17.8 billion yen).

While the export of Akoya cultured pearls is on a recovery trend, it is also true that the Japanese pearl industry is facing various problems such as the aging of producers and the decrease of mother oyster resources.

Environmental initiatives

In recent years, productivity of pearl culturing has declined due to the deterioration of the fishing ground environment over the years, and there have been concerns about a decline in the

quality of pearls produced. It is an undeniable fact that the Akoya pearl oyster resource in Japan continues to decline due to the development of coastal areas and pollution of inland bay waters.

In marine areas where Akoya oysters are cultivated, the amount of phytoplankton increases as a result of nutrients such as nitrogen and phosphorus flowing in from the land. As a result of feeding on these plankton, Akoya oysters grow. However, if cultivation is carried out in excess of appropriate quantity, natural purification capacity is exceeded and the sea is polluted.

With this in mind, and with the idea of environmental protection and industrial sustainability in the background, research teams from industry, government, and academia are engaged in the development of technologies to reduce environmental impact of pearl cultivation and research into recycling-based aquaculture for environmental conservation.

This trend has spread to several regions and organizations which is working to establish and disseminate composting technology with the aim of achieving sustainable pearl cultivation that does not impose an environmental burden. In particular, a collaborative team of Mikimoto Group is promoting establishment of the concept

of “zero emission” in pearl cultivation as part of this research.

In this “zero emission,” pearls and shells have been used in jewellery, ornaments, and mother-of-pearl inlays, while adductors have been consumed as food. On the other hand, in the advanced use of Akoya oyster, mantles have been transformed into cosmetics that make use of pearl collagen, and shells and pearls that do not become gems have been transformed into health foods. In addition, the residue left over from advanced use process, such as shell meat and adhesion, is composted and used to grow fruits and plants.

In this way, all of the Akoya oyster is used and the burden of aquaculture waste on the fishing ground environment is reduced as close to zero as possible.

The Fisheries Agency is also promoting initiatives to achieve both the sustainable use of fishery resources through the use of cutting-edge technologies such as Information and Communication Technology (ICT) and the Internet of Things (IoT).

Utilization of IoT can also be seen in a joint project between Mie Prefectural Fisheries Research Institute and other companies. This project aims to improve productivity and revitalization of Akoya pearl culturing by reducing the damage caused by red tides and poor oxygen.

Genome research

In recent years, development in analytical equipment have led to rapid advances in research on genes and genomes, bringing about major changes in various fields. With the advent of next-generation sequencers at the beginning of the 21st century, research on genes and genomes of Akoya pearl oyster has also accelerated.

In 2011, The University of Tokyo and Mikimoto Group succeeded in obtaining almost all the genetic information related to the formation of the nacreous layer of Akoya pearl oyster in a joint study. The following year, Okinawa Institute of Science and Technology Graduate University (OIST), The University of Tokyo and Mikimoto Group succeeded in decoding the genome of



Akoya shell awaiting re-purposing on a pearl farm in Japan.

Japanese pearl oyster owned by Mikimoto for the first time in the world.

Furthermore, in 2022, an OIST research team, Mikimoto Group, and Japan Fisheries Research and Education Agency (FRA) conducted joint research and succeeded in reconstructing the genome of Akoya pearl oyster with a high degree of accuracy. The results of this research were published in the scientific journal DNA Research.

The significance of decoding the Akoya pearl oyster genome is to elucidate the mechanism by which pearls are produced, to establish a foundation for quality control of Akoya pearl oysters, and to establish a foundation for the protection of Akoya pearl oyster. Through the use of this genome information, it is expected to prevent the mortality of Akoya pearl oysters, which has occurred frequently in recent years, and to contribute to the cultivation of Akoya cultured pearls.



AUSTRALIA

Peter Bracher, Executive Director, Sales and Distribution, for Paspaley Pearling, and also a Vice President of the CIBJO Pearl Commission, provides the perspective of a producer of South Sea Pearls.

Demand for South Sea cultured pearls has been exceptionally strong since late 2020 and that prices are now well above pre-COVID levels.

The Paspaley company's production volumes remained stable through the pandemic. The South Sea cultured pearl production cycle is long and costly and is not something that can just be turned on and off. Peter states that Paspaley is currently experiencing supply shortages in most categories, but this is related to increased demand rather than anything to do with the pandemic.

Elucidating further he has stated that demand for clean, high-quality cultured pearls in classic shapes was particularly strong during this period, and prices for these categories continue to experience steady growth each month. Since the beginning of 2023, demand and prices for other categories of pearls such as commercial qualities and non-classic shapes have also been rising steadily.

The rising prices are due to a number of factors.

Firstly, pearls have become very fashionable in recent years. They are no longer regarded as a conservative choice for older women and are now being worn by actors, singers, sportspeople and women and men of all ages. This is partly because of their casual elegance but also because they are regarded as an ethical and sustainable choice in jewellery.

Another factor is that production levels are significantly lower than they were ten years ago. Many traders held significant stocks which have now been depleted which means demand must be supplied from the annual production rather than from stock that is held by wholesalers.

The high cost and long production cycle of South Sea cultured pearls means that production can only be increased incrementally over a number of years. This means that production levels are likely to remain stable for the foreseeable future and supply will remain tight.

The final factor is that demand from markets such as China and India has increased significantly and is now competing with demand from the established markets such as the United States, Japan and Europe. Put simply, there is greater demand for fewer pearls.

Peter reports that production levels are stable and Paspaley has yet to see any signs that would indicate a fall in demand. He expects prices to continue to rise for the remainder of 2023 and into 2024, however, not at the same accelerated rate as it did through 2022.

Finally, Peter states that it is important to remember that, although shape influences the price of pearls, it is not a quality factor. The price of round pearls has increased significantly in recent years but pearls of exceptional quality in other shapes are still available at comparatively reasonable prices. These shapes can be very appealing and, in many cases, are even preferable when it comes to creative jewellery design.

One of the most appealing things about South Sea cultured pearls is that they come in so many shapes and sizes. This is great for designers, jewellers and consumers wishing to express their individuality with something other than the

GEM LABORATORY CONTRIBUTIONS

The Gemological Institute of America (GIA), the Swiss Gemmological Institute (SSEF) and the Bahrain Institute for Pearls and Gemstones (DANAT), all of which have extensive pearl-testing laboratories, are CIBJO members that have contributed greatly over the years through their expertise and research. New discoveries are constantly being made. In this section of the Pearl Commission's Special Report we are provided with a snap-shot of some of their more recent interesting discoveries.

familiar round, drop or button shapes.

Gemological Institute of America

(GIA)

Disordered dolomite center in a natural Cassis pearl

GIA recently studied a natural pearl from a mollusc of the Cassis species containing granular central structures, which had reportedly found in Indonesian waters.

Macro- and microscopic images on the surface and cross-section of the sample are shown in Figure A. Its yellowish brown surface exhibited a mottled appearance lacking any aragonite platelet layers, suggesting it to be non-nacreous, which is expected for pearls formed in Cassis species.

The cross-section showed multiple white growth zones with brownish growth rings, as well as subtle flame patterns due to their crossed-lamellar microstructures. More interestingly, the center region of this pearl revealed

an area of numerous spheroidal aggregates with each having an approximate diameter ranging from 30 to 60 μm in size.

Raman spectroscopy, laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS), energy dispersive X-ray spectroscopy (EDS) coupled with scanning electron microscope (SEM), and X-ray diffraction (XRD) analyses were carried out in order to characterise the mineral composition in the center region of this pearl. The results showed that this pearl's center was

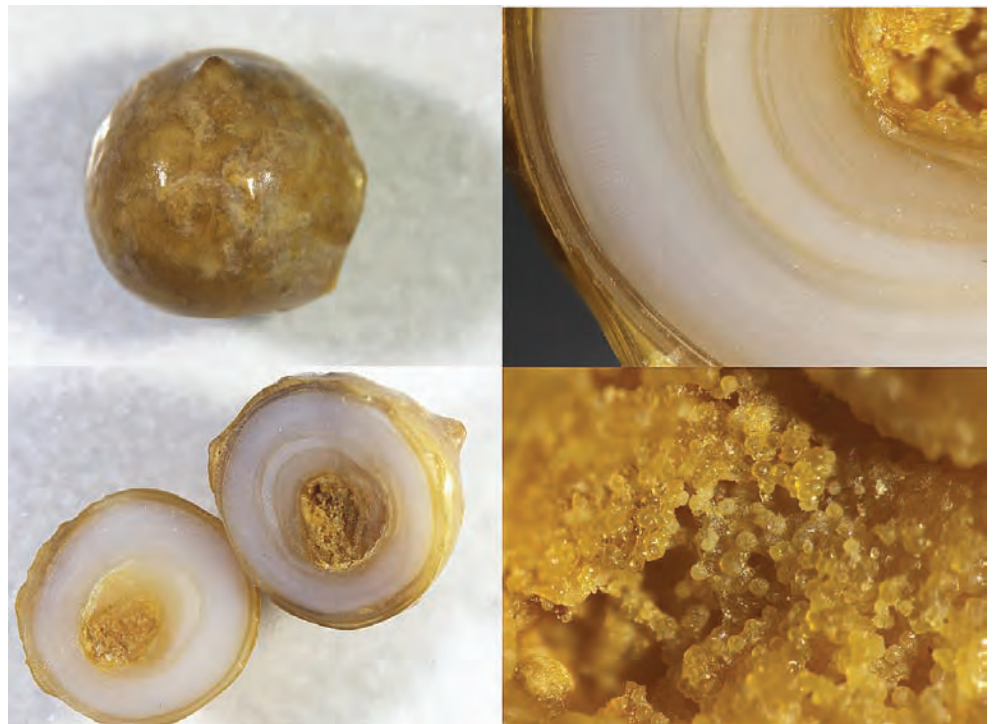


Figure A: Macro- and microscopic images on the surface and cross-section of the pearl showing its various growth structures. Photo courtesy of GIA..

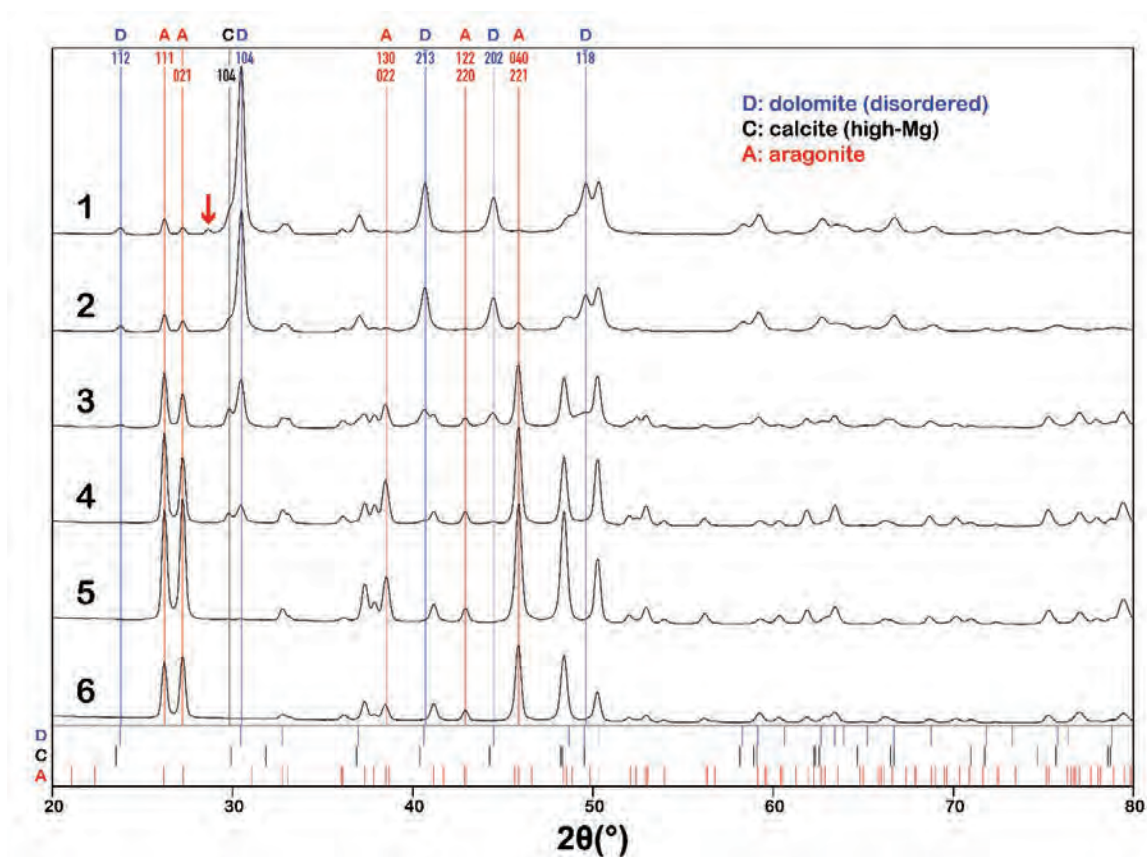


Figure B: The XRD patterns integrated from the Debye rings collected in-situ on the pearl sample. Spots 1 to 6 are from the center region toward the outer region on the cross section of the pearl.

made of mostly disordered dolomite, mixing with small amount of aragonite and high magnesium-calcite.

In-situ XRD data suggested that the white region and brown crust of the cross section were composed of only aragonite, with no detectable signal from any other phases (Figure B). In addition, trace elemental analyses confirmed that the high concentrations of Mg was only found in the central region of the pearl, up to 10.7 weight percent. While the theoretical Mg concentration on the disordered dolomite calculated based on the XRD result is 12.32 weight percent, the experimental result was very close to the calculated result.

To GIA’s best knowledge, this is the first time disordered dolomite has been directly detected inside of a natural pearl. It provided a rare opportunity and invaluable insight into what natural biomineralization process and pearl formation could happen. It is likely that more

interesting compositions at the core of pearls are waiting to be discovered, which are still widely unknown and waiting to be explored.

A full research article on this topic was published this year (<https://doi.org/10.1371/journal.pone.0284295>).

Natural non-nacreous pearl from *Telescopium telescopium*

GIA’s Bangkok laboratory examined an unusual yellowish brown and black non-nacreous button-shape pearl weighing 1.72 carats. The client informed GIA that the pearl was found in a *Telescopium telescopium* shell.

This edible snail was retrieved from an abandoned shrimp pond near a mangrove forest in Krabi, Thailand. The story of the pearl’s discovery was widely publicized in the local media. Though the client was unable to submit the shell from which the pearl was extracted, they provided

the lab with samples of the same type of shell for further study (Figure C).

The pearl and inner part of the shells exhibited similar attractive porcelain-like luster and flame structures consistent to those routinely observed in other types of porcelaneous pearls. Intersecting and overlapping flame structures typically observed in pearls from the *Cassis* genus were also detected on the pearl and shells.

However, the banded structure observed on the cut shells was not visible on the pearl, which is an additional evidence that the item was a pearl and not an imitation fashioned from shell (Figure D).

A lab note on these interesting samples was published in *Gems & Gemology* (Lab Notes section, Fall 2022, Vol. 58, No. 3), which contained additional analytical results conducted on them. This added to the growing list of natural pearls found in edible oysters and snails described in the literature.



Figure C: The The 1.72 -carat yellowish brown and black non-nacreous pearl with

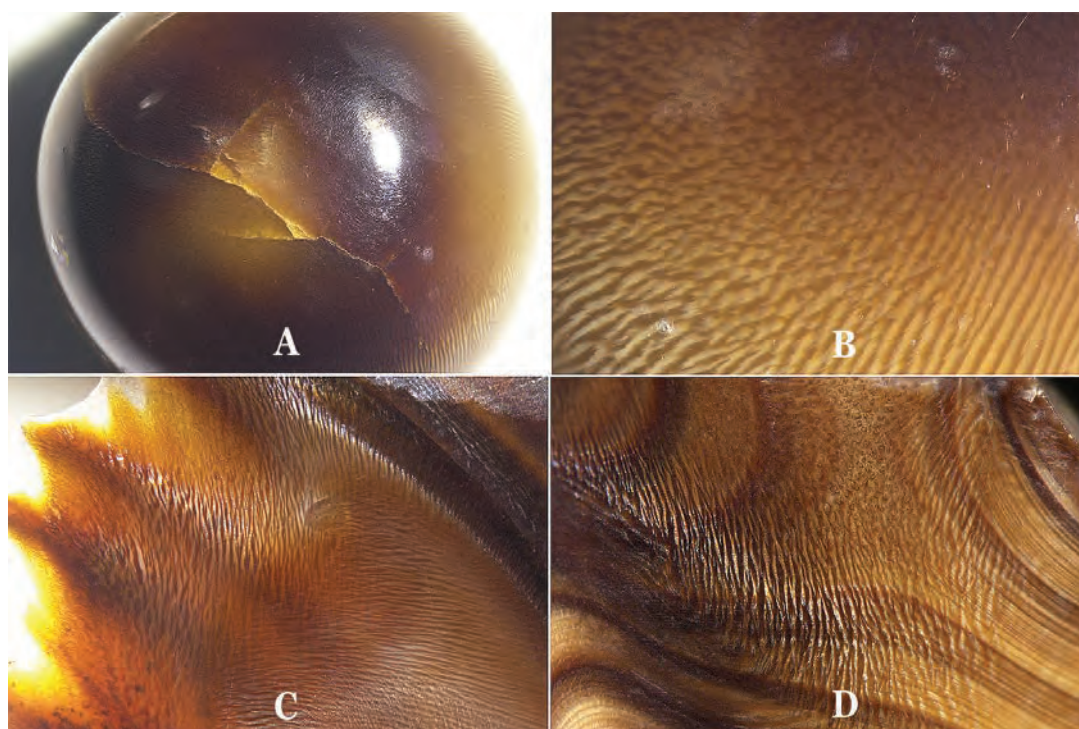


Figure D: (A) Obvious long cracks traversing the pearl's darker side; field of view 7.20 mm. (B) Intersecting flame structure on the pearl; field of view 2.40 mm. (C) Intersecting flame structure on a cross section of the shell; field of view 4.80 mm. (D) Banding and flame structure on a cut area of shell; field of view 4.80 mm. Photo courtesy of GIA.

It was the first time a natural pearl has reportedly been discovered in a *Telescopium* species. Its unique appearance and characteristics provided a rare opportunity for gemologists to examine and record data from a natural pearl originating from this marine snail.

Swiss Gemmological Institute (SSEF)

Age dating & DNA fingerprinting technology in pearl testing

Research into species determination and radiocarbon age dating pearls is contributing to greater knowledge about the provenance of historic natural pearls. An excellent example of such research is the study of the Queen Mary Pearl, a beautiful drop-shaped saltwater natural pearl of 41 carats.

Based on the provided documentation, the Queen Mary Pearl belonged originally to Queen

Mary (1867-1953), wife of King George V of England (1865-1936). The important pearl was then passed on to the following generations within the royal family until it was eventually sold some years ago.

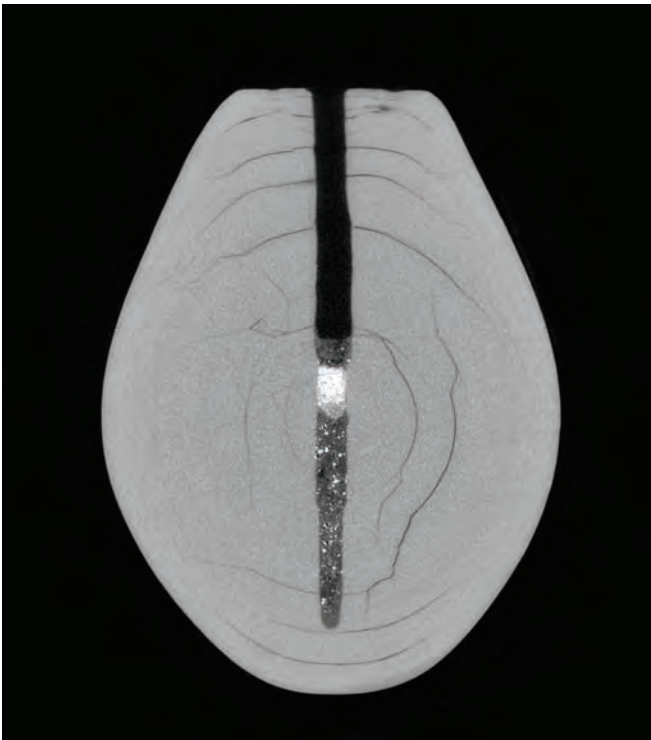
As it was submitted as an unmounted loose pearl, not only could a full X-ray tomographic study of the internal structures of this historic pearl be carried out, but it was also possible to take minute nacre powder samples (about 20 mg in total) from within the pre-existing drill-hole for DNA fingerprinting and radiocarbon age dating analyses.

Radiocarbon dating is a scientific method used to determine the age of materials containing ^{14}C , an unstable isotope of carbon. This method was developed in the late 1940s by Willard F. Libby, who received the Nobel Prize in Chemistry in 1960 for his ground-breaking research.

The results of the radiocarbon dating performed at a specialised research laboratory of the Swiss Federal Institute of Technology in Zurich reveals an historic age for the analysed pearl. As it is often the case with radiocarbon dating,



The Queen Mary Pearl set as a pendant in a necklace. This pearl of 41 ct exhibits a delicate slightly grey colour and a very fine and smooth pearl lustre. Photo: L. Phan, SSEF.



X-ray tomographic section of the Queen Mary Pearl, exhibiting a (half) drill-hole partially with some residues from the former jewellery setting, and several ring structures as is characteristic for natural pearls. Figure: J. Braun, SSEF

the determined age indicates a period in history rather than a precise date. Based on SSEF's data, the pearl probably formed between 1707 and 1876 in coastal waters along the Pacific coast of

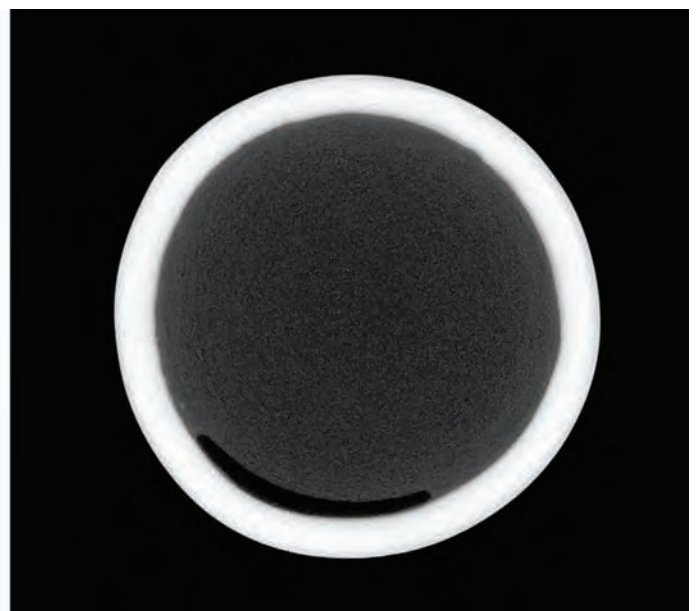
Mesoamerica. The historic region comprises the modern day countries of northern Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Belize, and central to southern Mexico. For thousands of years, this area was populated by groups such as the Olmec, Zapotec, Maya, Toltec, and Aztec peoples.

DNA analysis unambiguously revealed that the Queen Mary Pearl belongs to the *Pinctada mazatlanica* species, commonly known also by the name Panama pearl oyster or La Paz pearl oyster. This species is found off the Pacific coast of Mesoamerica from the Baja California (Mexico) to Ecuador and northern Peru.

Adopting a combined approach of age dating and DNA fingerprinting in testing historical natural pearls is also an opportunity to better understand pearl oyster genetics and gain deeper insights into historic pearl trading routes.

Unconventional bead material

Recently, SSEF received a round pearl for testing which exhibited an excellent surface quality and a remarkable size of 24 millimetres in diameter. Interestingly, its weight of 60 carats was rather low for such a pearl (resulting in a calculated specific gravity of approx. 1.61 instead of 2.715 considered standard for a pearl).



Cultured pearl of 24 mm diameter. The X-ray tomography section (right) reveals the unconventional bead material (dark grey) of this cultured pearl. Photo: SSEF.

Using X-radiography and micro X-ray tomography, its identity as a beaded cultured pearl and the reason for this low weight was quickly revealed.

The saltwater cultured pearl contained an unconventional organic bead material, possibly similar to those described in 2013 in an article in the Australian Gemmologist (Cartier & Krzemnicki, 2013). Nearly transparent to X-rays, this bead material showed no internal structure except a fine granular texture and some empty cavities (black) along the bead/nacre interface. The cultured pearl was undrilled, so the identity of the bead material could not be further tested.

In terms of market acceptance, it might be interesting to see if more such cultured pearls arrive on the market in future. For SSEF, it was the only one in the past several months. Another interesting aspect would be to see the long-term stability of such organic bead material, especially if the pearl would be drilled and strung on a necklace.

The Bahrain Institute for Pearls and Gemstones (DANAT)

A pearl produced by *Saccostrea cucullata* in the Bahrain pearl beds

The waters of the Arabian Gulf are famous for the presence of vast pearl oyster beds. While they are rich with different types of molluscs, the dominant species are *Pinctada radiata* followed by the *Pinctada nigra* and *Pinctada margaritifera*. Rarely have pearls been reported in species other than the Pinnidae family in this region.

Previously there were several reports of the presence of *Saccostrea cucullata* (common name the hooded oyster or Natal rock oyster) in the pearling beds of the region. These reports documented the presence of the bivalve in the waters of Kuwait, Iran, Oman and the UAE. However, they did not document the presence of a natural pearl within this mollusc.

The research team from DANAT have found,

for what is believed to be the first time, a small natural pearl within a *Saccostrea cucullata* that was fished in Bahraini waters. As this appears to be an original discovery, the shell and pearl were documented in terms of their morphological, structural, and chemical features. The natural pearl will be a unique addition to the pearl oyster database used for origin determination.



The specimen of Saccostrea cucullata specimen found in Bahraini waters. Photo courtesy of DANAT.



The 0.8 carat pearl found in the Saccostrea cucullata (the hooded oyster or Natal rock oyster). Photo courtesy of DANAT.

The *Saccostrea cucullata* specimen found in Bahraini waters matched the reported descriptions for this species which are known for their morphological plasticity and variation in shell characteristics (Amaral and Simone, 2016;

Lam and Morton, 2006). Indeed the rock like appearance of the shell and the radiating ridge presented challenges in the shucking of the oyster.

The inner surface of the shell was white in colour at the base of the specimen. The area below the abductor muscle region was dark brown in colour and the lip transitions from brown to dark brown in colour. Furthermore, the umbral cavity was deeper at the ventral valve than at the dorsal.

The pearl found in the *Saccostrea cucullata* measured 2.07 x 2.04 x 1.94 millimetres and weighed 0.08 carats. It is white, symmetrical oval with no luster, overtone or orient. The colour of the pearl was similar to that of the inner shell.

References:

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