



## TCC NATURAL CONSERVATION DEVELOPMENT

### MANAGEMENT APPROACH

TCC upholds strict self-management standards and requirements for nature-related business activities. All TCC-owned mines passed environmental impact assessments (EIAs). TCC performs impact projections and assessments regularly, proposes countermeasures or alternative solutions to prevent or mitigate environmental impacts from development, and carries out quarterly monitoring of environmental impacts in mining areas in line with the plans committed. To track the progress of mine plant restoration efforts, TCC surveys the plant growth in the mines monthly and implements ecological restoration projects to facilitate restoration of biodiversity locally.

#### STEPS - 1

##### AVOID

100% pass the government's EIA review, uphold zero deforestation beyond the red line of mining areas, maintain the original ecosystems, and avoid decisions that result in negative impacts on the high-importance natural environment.

#### STEPS - 2

##### REDUCE

Reduce biodiversity impact through scientific methods and innovative technologies; adopt the Hilltop Platform Mode Phased-excavation, systematic explosion management and monitoring to reduce noise and dust pollutions; employ a fully enclosed vertical shaft transport system to reduce interference and carbon emissions from truck transport in order to reduce the overall impact on the environment.

TCC carries out natural conservation actions in accordance with the "Biodiversity Conservation and Sustainable Management of Living Natural Resources—Mitigation hierarchy" proposed by the International Finance Corporation (IFC) of the World Bank. The primary sites for restoration include the Hoping Mine, Suao Taibaishan Mine, and Hoping EcoPort.

#### STEPS - 3

##### RECOVERY

Protect and restore the degraded natural environment affected by business activities, 100% enforce the biodiversity management plans for mines, conduct environmental monitoring quarterly, and work with internal and external units for ecological restoration.

#### STEPS - 4

##### REGENERATE

Engage in the long-term soil monitoring and research of mines, soil biodiversity monitoring, and analysis of the pedogenic properties at mines to achieve an optimal restoration.

#### STEPS - 5

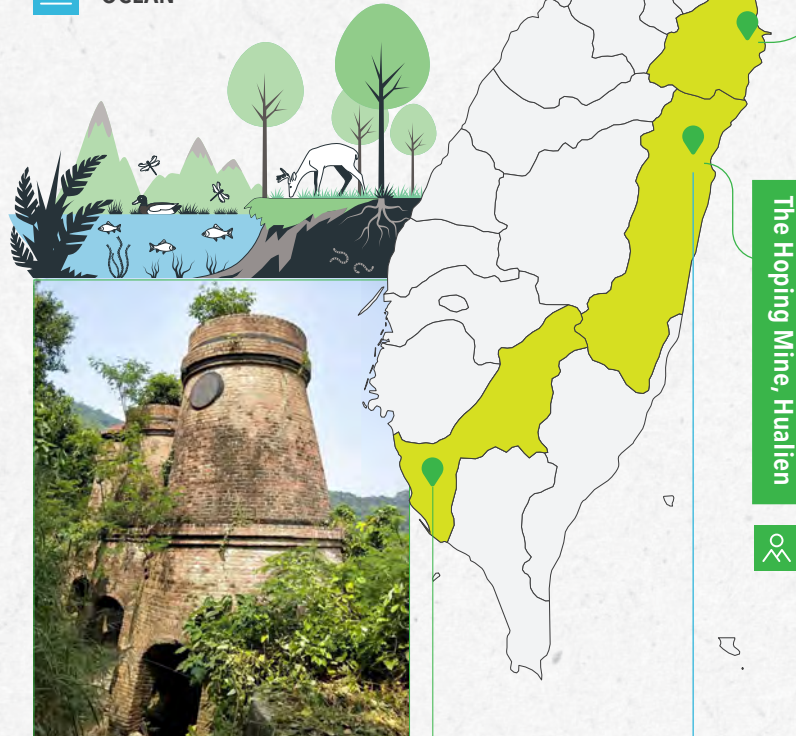
##### TRANSFORM

At the first semi-closed ecosystem experimental base in the world, introduce thousands of plants and continuously observe and practice the evolution process of restoring plants to the wild. Introduce renewable energy and energy storage applications to plants, build large-scale energy storage systems, and utilize the energy storage project sites on the plants to create the first low-carbon green energy park in the eastern Taiwan.



### 3.1 | Status and Planning for the Focused Business Areas of TCC

- LAND
- OCEAN



The Shoushan Mine, Kaohsiung

- ▲ Detention basin for public safety and ecological protection
- ▲ Protection of habitats for the flora and fauna on the blue/green belts
- ▲ The red-brick warehouse and limestone kiln registered as historic buildings



Hoping EcoPort, Hualien



- ▲ OCA Class-A Water, PERS certification renewed, and GPAS certified
- ▲ EPA Environmental Education Facility certified
- ▲ The Water Environment Watch established by employees and certified by the Environmental Protection Bureau, Hualien County

**Bio Cube Coral Creation Project**

- ▲ 288 corals restored with the overall restoration rate at 89%
- ▲ 100% of the survival rate for coral larvae
- ▲ 3 times of area restored compared to that in the beginning



Suao Taibaishan Mine, Ilan



- ▲ The first microirrigation system in Taiwan with PV and energy storage combined
- ▲ Installation of windbreak drywall nets to block the wind
- ▲ 198 metric tons of rainwater harvested per year with 65 rainwater harvesting ponds
- ▲ 14.91 hectares of area greened
- ▲ 71.81% of the survival rate of large arbors after being transplanted

The Hoping Mine, Hualien



- ▲ The first adoption of the low-carbon vertical shaft transport system in combination with the Hilltop Platform Mode Phased-excavation
- ▲ Creation and enhanced monitoring of habitats, installation of nesting boxes for birds, ecological ponds, and 18 automatic IR cameras
- ▲ 48 hectares of area greened
- ▲ 95% of groundcover plant coverage on average
- ▲ 2,040 trees per hectare for the average tree planting density with the average survival rate at 98%

TCC stresses on mine restoration and local biodiversity conservation and has always taken the restoration of the original landscape of limestone mines as its main goal. Generally, the topsoil on which plants grow will be removed directly in mining. The restoration that follows involves moving in the soil from elsewhere, and even the fast-growing alien tree species (e.g. White Popinac) will be adopted as the greening plants. TCC employs the most natural and non-instant restoration method, retaining the topsoil as the provenance to rebuild the original habitat. In the initial stage of mine restoration and evolution, the species to be restored were selected using the six criteria recommended by KBCC: the intolerant (pioneer) plants played an important role. The intolerant species were cultivated first to provide shade, and then the tolerant species were planted in phases, to enrich the growth environment in the mines.



Indigenous species first; trees fit for the area selected



Pilot introduction of pioneer plants for greenification



Utilization of soil and seed bank



Fast-growing alien tree species replaced by indigenous species



Mid-succession used for estimated seedling required



Species with economic values first

## Six Principles for Mine Ecosystem Restoration



**LAND**

**3 Steps for Greenification in the Hoping Mine**

**STEPS - 1**

**Sapling cultivation at nursery Preparation stage**

- ▲ Cultivate pioneer saplings; transplant and raise saplings of precious and rare plants.
- ▲ Set up the nursery of over 1,10m<sup>2</sup> to cultivate approximately 4,000 indigenous saplings per year, including White Beech, Formosan Ash, Formosan Alder, Chinese Soap Berry, and Ring-cupped Oak.

**STEPS - 2**

**Acclimatization at hardening facility**

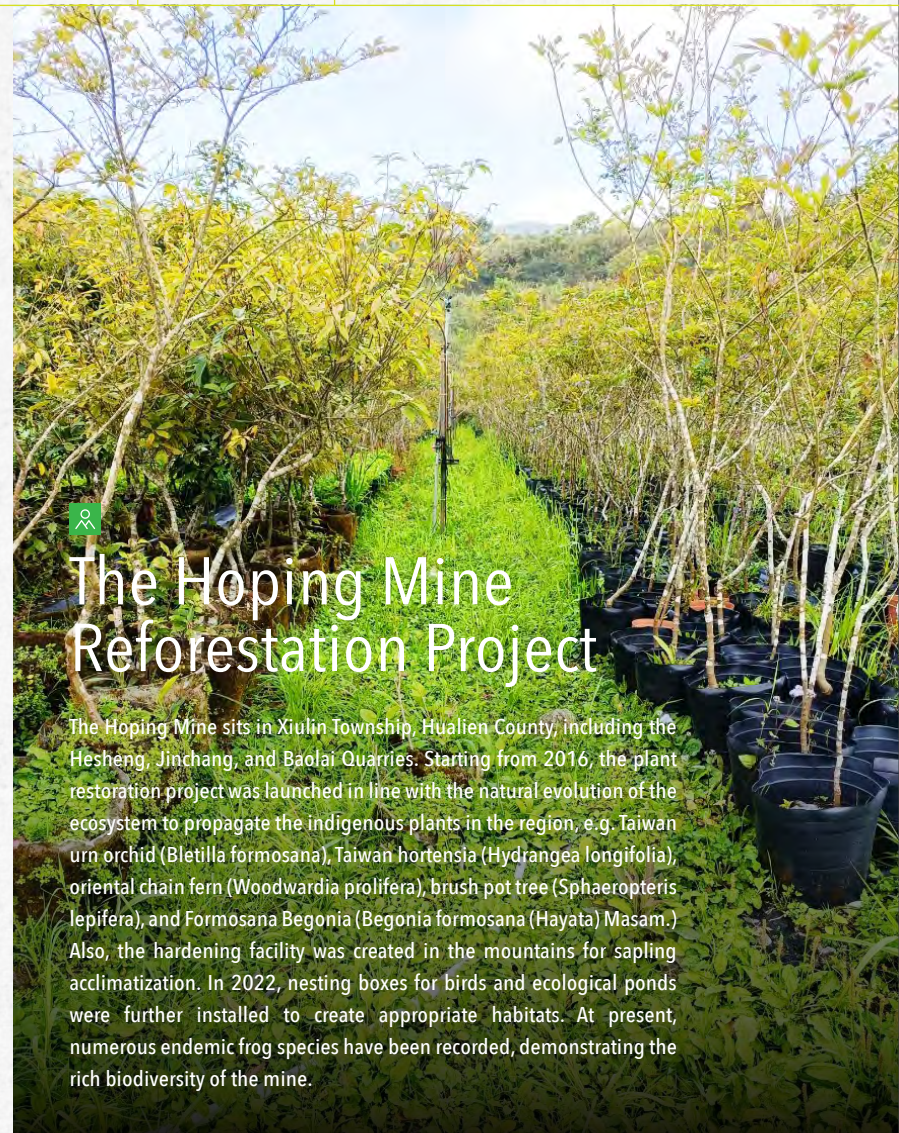
**Pre-forestation stage**

- ▲ Cultivate the existing dominant species in the original habitat.
- ▲ The saplings are repotted after half a year of cultivation and moved to the hardening facility in the mountains for acclimatization to adapt to the climate at the mine.

**STEPS - 3**

**Green restoration Reforestation stage**

- ▲ The saplings are transplanted to the final residual walls upon reaching to a height of 1.5 to 2 meters.
- ▲ Focus on the indigenous broad-leaved tree species to expand the scale of restoration to rock wall ecology and the large platform for greenification.



**The Hoping Mine Reforestation Project**

The Hoping Mine sits in Xiulin Township, Hualien County, including the Heshang, Jinchang, and Baolai Quarries. Starting from 2016, the plant restoration project was launched in line with the natural evolution of the ecosystem to propagate the indigenous plants in the region, e.g. Taiwan urn orchid (*Bletilla formosana*), Taiwan hortensia (*Hydrangea longifolia*), oriental chain fern (*Woodwardia prolifera*), brush pot tree (*Sphaeropteris lepifera*), and Formosana Begonia (*Begonia formosana* (Hayata) Masam.) Also, the hardening facility was created in the mountains for sapling acclimatization. In 2022, nesting boxes for birds and ecological ponds were further installed to create appropriate habitats. At present, numerous endemic frog species have been recorded, demonstrating the rich biodiversity of the mine.

**RESTORATION CHALLENGE**

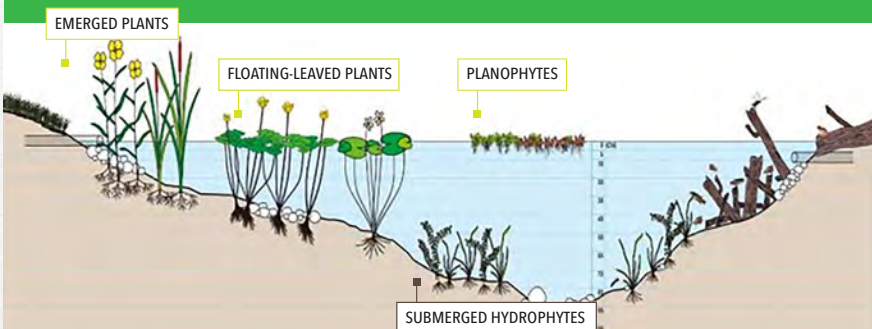
Because there are multiple slopes in the Hoping Mine, it is prone to disasters if there is a heavy rain and flood, which will affect the ecosystem.

**SOLUTIONS**

- ▲ Establish platform ditches, drain ditches, large-scale silt detention basins, and other facilities in accordance with the soil and water conservation plan.
- ▲ Set up solid rock embankments at a height of 2 meters or higher for the slopes at the side of the mine to prevent significant impact of heavy rain on the surrounding ecosystem.

**Ecological Pond**

The endemic frog species, such as temple tree frog and Chou's stream tree frog, have been constantly observed in the humid area at the Hoping Mine, presenting a rich amphibian ecology. In 2022, part of the hinterland of the mine was transformed into ecological ponds to store rainwater and surface runoff with a depth of 1 meter. Also, planophytes and submerged hydrophytes are grown to serve as the habitat for frogs and for animals to rest and drink water. Crested Serpent Eagle, Formosan Serow, muntjac, etc. were recorded at present.



**3 Steps for the Basic Survey of the Suao Taibaishan Mine**

**STEPS - 1**

**Establishing Base Site Survey Database**

Set up micro-climate monitoring stations across all restoration platforms to systematically map out the topography of the mine, mountain slopes impact, wind speed, wind direction, and temperature changes to establish the base survey database.

**STEPS - 2**

**Planting technology research**

- ▲ Plan the greenification area with the trees fit for the area in line with the varied altitudes and topographical differences.
- ▲ Find the best planting methods for indigenous trees, along the right seasons (solar terms) and the use of green manure and top dressing, to speed up the recovery of autogenic succession.

**STEPS - 3**

**Analyzing Soil Physicochemical Properties**

- ▲ The alkaline composition of the soil in the karst topography of the Taibaishan will increase with mining, and the alkalized soil will make it difficult for plants to grow.
- ▲ Implement various soil dressing amendment projects, add natural organic compost like mushroom bulk bags, chicken manure compost, etc., to balance the physical / chemical properties of the soil.

**RESTORATION CHALLENGE**

**CHALLENGE 1 |**

**Mild-typhoon-level fierce wind for years**

The wind is strong at the windward side of the northeast monsoon of the Taibaishan, with the wind speed measured throughout the year always two levels higher than that of the Suao Weather Station, rendering trees unable to grow back on the windward side for decades.

**SOLUTIONS**

- ▲ Install windbreak drywall nets to block the wind, which can reduce the wind speed by 3 levels.
- ▲ The windbreak nets with the density at 60% in the restoration area ensure a successful growth of plants, effectively mitigating the damage from strong winds and facilitating the survival of the transplanted plants.

**CHALLENGE 2 |**

**The Karst terrain without water sources**

The Taibaishan are all karst terrain, which pose a challenge in water retention as water seeps through the rocks to the lower layer and cannot be effectively retained.

- ▲ Use high exposure of morning mountain sun for a PV-powered microirrigation system, pumping water to a 900 meter high mine for restoration.
- ▲ Each restored sapling gets a dedicated microirrigation hole, angled at 30 degrees or less for precise watering for new plantings.
- ▲ Install rainwater harvesting ponds to the part of restoration platforms for emergency watering plants
- ▲ The windbreak nets can block some vapors and improve the soil moisture.

**CHALLENGE 3 |**

**Destruction of vegetation and infrastructure by the animals returning to the wild**

After returning to the wild in the mine, the animals gnaw on saplings and dig the soil, presenting challenges to the seedling restoration and irrigation pipeline maintenance.

- ▲ Set up white strips in the areas where mammals are mostly observed in the manner of least interference for deterrence.
- ▲ Plant pumpkin, sweet potato, potato, yam, taro, chayote, and other crops interspersed, to divert mammals from eating saplings temporarily.
- ▲ Enhance plant resilience by building a under-mountain nursery and a hardening facility for mature plant relocation to the mine.

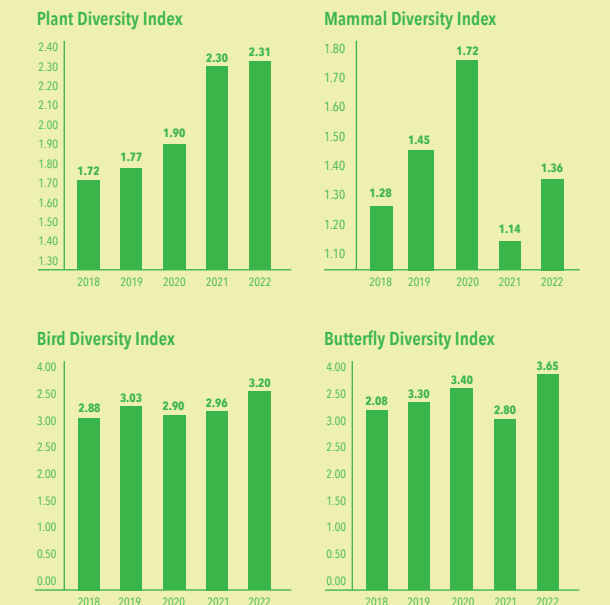


**The Suao Mine Ecological restoration project**

Taibaishan located in Suao, Yilan, has been an important mining area since 1934 during the Japanese Rule. It shares an intimate tie with the economic development in Taiwan. However, the data of local topography, ecology, and hydrology are rather scarce. Since TCC took over the region, it has been restoring the mine step by step. Starting from 2017, TCC has been working with the professor of the Department of Horticulture, NIU, inventing new restoration methods, including installation of the first microirrigation system in Taiwan with PV and energy storage combined, precision irrigation, windbreak nets to block strong winds, and rainwater harvesting ponds to overcome the water retention challenges presented in the karst topography. Through the various innovative approaches, TCC overcame the harsh environment for restoration and safeguard biodiversity.

**The Hoping Mine & the Suao Mine Restoration Performance**

Biodiversity makes the bedrock of the ecosystem services provided by nature. Aiming for restoration of ecosystem as a whole, TCC has been tracking and monitoring the diversity of the flora and fauna species in the mines, which serve as the indicators of the restoration performance.





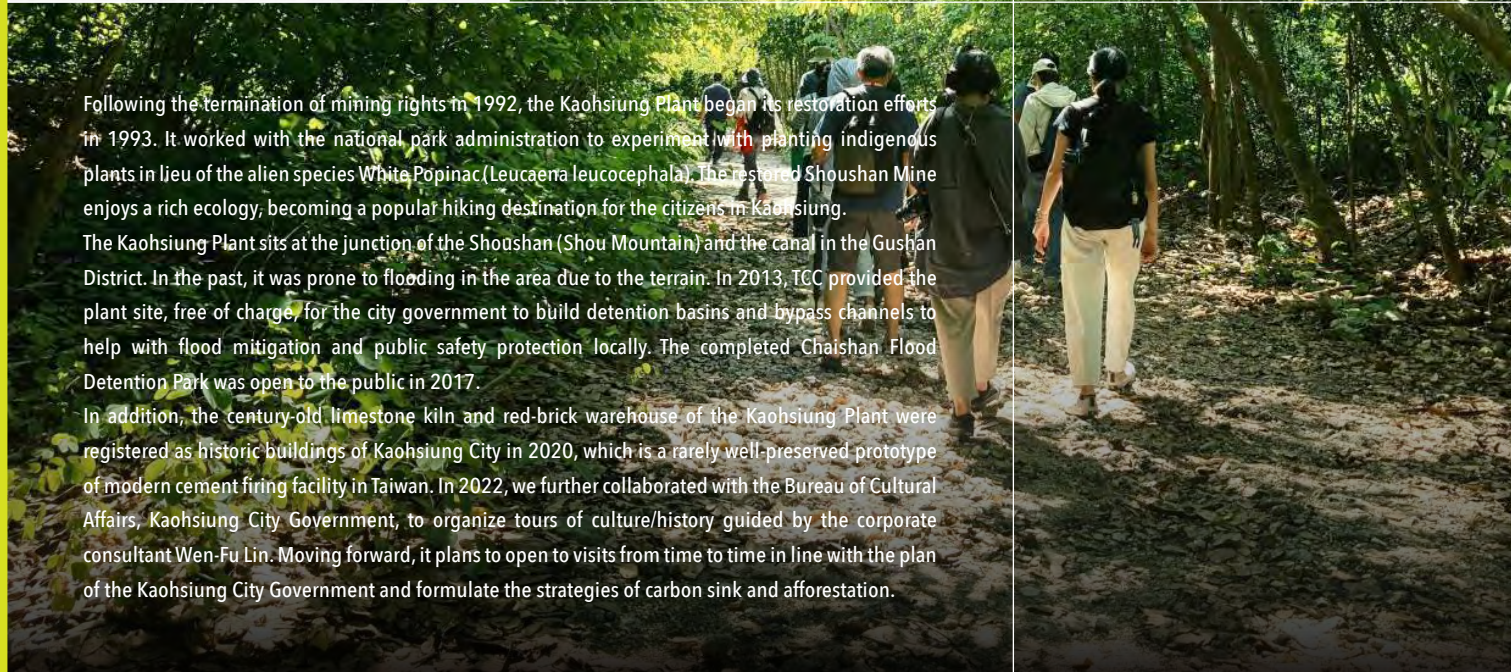
# The Shoushan Mine Ecology-Culture Coexistence Project



Following the termination of mining rights in 1992, the Kaohsiung Plant began its restoration efforts in 1993. It worked with the national park administration to experiment with planting indigenous plants in lieu of the alien species White Popinac (*Leucaena leucocephala*). The restored Shoushan Mine enjoys a rich ecology, becoming a popular hiking destination for the citizens in Kaohsiung.

The Kaohsiung Plant sits at the junction of the Shoushan (Shou Mountain) and the canal in the Gushan District. In the past, it was prone to flooding in the area due to the terrain. In 2013, TCC provided the plant site, free of charge, for the city government to build detention basins and bypass channels to help with flood mitigation and public safety protection locally. The completed Chaishan Flood Detention Park was open to the public in 2017.

In addition, the century-old limestone kiln and red-brick warehouse of the Kaohsiung Plant were registered as historic buildings of Kaohsiung City in 2020, which is a rarely well-preserved prototype of modern cement firing facility in Taiwan. In 2022, we further collaborated with the Bureau of Cultural Affairs, Kaohsiung City Government, to organize tours of culture/history guided by the corporate consultant Wen-Fu Lin. Moving forward, it plans to open to visits from time to time in line with the plan of the Kaohsiung City Government and formulate the strategies of carbon sink and afforestation.



Shoushan Detention Basin Bypass Channel



## OCEAN



# The Hoping Port Coral Creation Project

The Hoping EcoPort is located in "3-in-1 Port, Power, Cement Plant" in Hualien. With the circular economy thinking incorporated right from the design phase, it is the only circular production facility in the world with zero waste. The EcoPort is responsible for the everyday transportation of the raw materials and products of cement in and out. In this only dug-in port in Taiwan, a group of delicate guests brought by the Kuroshio Current—coral—reside for more than 2 decades.

The rigorous environmental management at the Hoping EcoPort has been certified against the Port Environmental Review System of EcoPorts (PERS) consecutively. The water quality is also recognized as the OCA Class-A Water, which is equivalent to that of the Penghu waters. It thus became the home for coral to spawn and grow to our surprise. TCC started the research on the ecosystem below water of the port in 2015. It also worked with Eco-Angel Environment Conservation Association to carry out the bio cube coral creation project in 2021 to transplant the corals broken by natural factors or the currents in the port to the cement bio cubes in the port.

### 3 Phases of Ecological Survey at Hoping Port

#### PHASE-1

**Life below water survey**  
2015

**National Taiwan Ocean University**

- ▲ Obtained the basic underwater ecological information in the port as the basis for the assessment of the ecological plan that followed.
- ▲ Monitored the port and the surrounding waters, including underwater photography, sediment sampling, and mapping of water temperature changes, etc.

#### PHASE-2

**Identification and distribution survey of the coral species**

2020

**Taipei University of Marine Technology**

- ▲ Identified indicator species as the metrics for monitoring and tracking that followed to establish the benchmark for the long-term environmental monitoring.
- ▲ Analyzed coral species composition and benthos coverage.
- ▲ Set up 120 50 - meter transect lines at depths of 3 meters and 6 meters to record coral species using the transect method.
- ▲ Corals in the port were found broken, which were determined to be resulted from the rich sediment in the existing area and the lack of substrates for attachment.

#### PHASE-3

**Bio Cube Coral Creation Project**

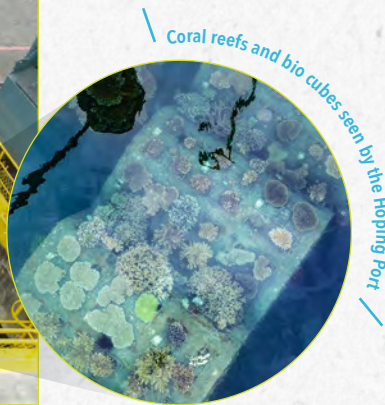
2021 to date

**Eco-Angel Environment Conservation Association**

- ▲ Due to the limited space in the port, the sculptability of cement and the micropores on the surface of the cement that allow attachment of algae are leveraged to create the cement bio cubes.
- ▲ The bio cubes placement passed the environmental impact assessment.
- ▲ With the dual-layer design adopted for the bio cubes, coral fragments are tied to the stainless steel meshes on the bio cubes' surface to avoid sediment coverage.
- ▲ The lower layer employs the lattice design for benthos to reside, with the goal to create a coral reef ecosystem.







Coral reefs and bio cubes seen by the Hopping Port

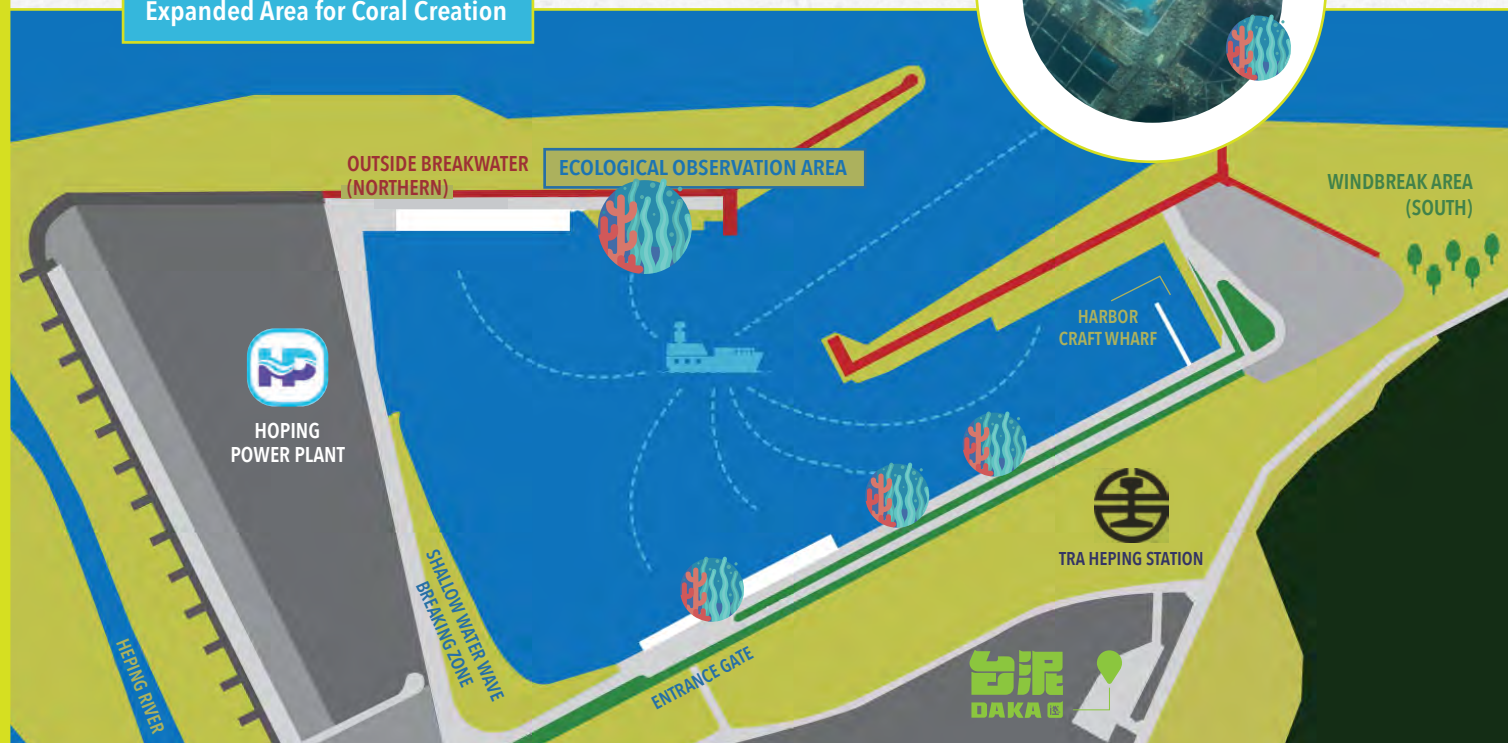
### Restoration Performance

As of February 2023, a total of 284 corals were restored at the Hopping Port with the overall restoration rate at 89%. In addition to the transplanted corals originally, the restoration team also found larvae of natural corals and protected species Tridacnae on the bio cubes growing at the speed above the average. This means that aside from asexual reproduction to expand their presence, coral fragments also undergo sexual reproduction for larval release, which indicates that the environment at the Hopping Port is very suitable for coral growth. At present, among the "residents" of the bio cubes, the 25 species of Acropora account for the majority, followed by 9 species of Merulinidae. The whole area restored has tripled compared to the initial area, covering 38% of the bio cubes, presenting a vibrant ecology.

In addition, 3 species of corals that had not been recorded in the eastern coast of Taiwan were found in the Hopping Port, namely Acropora caroliniana, Acropora bifurcate, and Turbinaria frondens. Since the main goal at this stage is to assist with the safe growth of coral fragments, some fragments broken from Turbinaria frondens were collected and

transplanted onto bio cubes as a key item for observation. Although coral reefs only account for 0.2% of the ocean, they are home to a quarter of marine life. TCC and the Hopping Port shall continue to invest in restoration and environmental education efforts. In 2023, the coral restoration site will be expanded to the extent of 1,000 corals. Also, together with the certification of environmental education facility obtained in 2022, we shall encourage the public to invest in marine conservation. In addition, from March 2023, the Hopping Port kicked off an ecological survey of fish and shellfish to identify the dominant species. It is to plan for the next stage of ecological development and continue the long-term monitoring and improvement on a rolling basis.

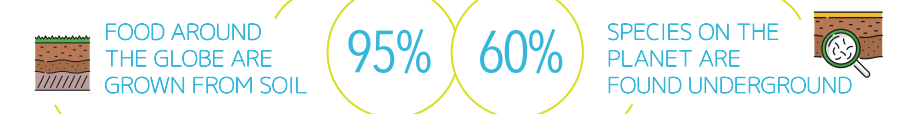
### Expanded Area for Coral Creation



## FORWARD LOOKING STUDY – Ho-Ping Ark Ecological Program

Nelson An-Ping Chang, TCC Chairman (2<sup>nd</sup> right); Chia-Wei Lee, CEO of KBCC (3<sup>rd</sup> left); Dr. Chiao-Ping Wang, Soil Expert (3<sup>rd</sup> right); Chih-Han Chang, Professor of NTU (middle); Chun-Ming Chen, Senior Collection Manager of KBCC (2<sup>nd</sup> left); Chia-Pei Wei, Plant Manager of Hopping Plant (1<sup>st</sup> right); and the research team.

Soil makes the source of species and life as well as the largest carbon sink on land.



The significance of soil to humans and nature is self-evident. However, there is no professional assessment mechanism in Taiwan at present that can effectively estimate the extent of soil changes, nor there is a systematic knowledge and assessment of the carbon cycle mechanisms in soil. It is impossible to effectively evaluate the impacts on the ecological environment and biodiversity in soil, either.

Hence, TCC promotes the "Ho-Ping Ark Ecological Program" (Ark Program) and works with the soil expert, Dr. Chiao-Ping Wang, and the team led by Professor Chih-Han Chang from NTU IEEB to carry out innovative ecosystem modeling, long-term soil monitoring and research, and professional cultivation. It involves mine soil sampling and testing, studying interactions between soil and plants on site, as well as the critically important research on the ecosystem functions of soil in the material cycle. With that, TCC endeavors to accumulate long-term soil observation and monitoring data as the key materials for the studies on soil biodiversity so as to realize the core vision of TCC, "living in harmony with nature."

At the beginning of the program, the expert team conducted research on the status of the greening of the residual walls in the mine. They found that the saplings appeared to be packing with poor potential. It is planned to strengthen the education and training on species selection moving forward.

Also, the phase 2 for afforestation experimentation is engaged to increase the amount of carbon sink via dense planting. Besides, the approach of direct seeding plus small seedlings is adopted in place of big seedlings. Furthermore, the research on the soil restoration technology for the residual walls in mine is launched as well.

In the future, the experimental base of the Ark Program will continue to introduce at least 1,000 plant taxa pursuant to its geographical microenvironment and experiment plan. Meanwhile, it shall continue to observe and practice the evolution process of restoring plants to the wild. It planned to invite the Taiwan Forestry Research Institute, Endemic Species Research Institute, and the scientific team of the National Museum of Natural Science to conduct surveys on the biology in the mine in an attempt to better capture the biological richness and assess for the priority species for conservation.

In addition, the experimental base will also develop towards an environmental education facility in the future. Combining the TCC DAKA Open Eco-Factory (hereinafter referred to as TCC DAKA) and the TCC DAKA Renewable Resource Recycling Center (RRRC), it endeavors to become the most characteristic environmental education and leisure facility in the eastern Taiwan.





**The first semi-closed ecosystem experimental base in the world**

**/ EXPECTED BENEFITS**

Remove alien species from outside the base, introduce thousands of valuable species, and conduct ecosystem rebuilding modeling to actively restore the species in the local ecosystem in search of cures for the future Earth ecosystem.

**/ WORK RESULTS**

**"Skynet-based Ark Plan"** established at the mine of the Hoping Plant with an area of approximately 1.45 hectares

**173 plant species transplanted**, including 783 orchids like Taiwan urn orchid (*Bletilla formosana*), *Bulbophyllum taiwanense*, *Papilionanthe taiwaniana*, and *Vanda lamellata*; 186 bromeliads; and 198 Apocynaceae plants

Discarded oil tanks from the mine repurposed as water tanks for the reclaimed tunnel water from Section B of Shaft 1 in the mine to be filtered before introduced to irrigate the plants in the Ark Plan, **with 74 metric tons of water reclaimed as of March 2023**



**Long-term soil monitoring and research**

**/ EXPECTED BENEFITS**

Conduct soil biodiversity monitoring and carbon decomposition experiments on the base and analyze the mine ecology restoration and the pedogenic properties. Achieve the optimal restoration of soil ecology in the mine and accumulate the long-term soil research data, including the soil fauna, soil microbiota, and physico-chemical analysis, and the research in the carbon sinks of soil and forest.

**/ WORK RESULTS**

Long-term monitoring of the decomposition of the large stubs on the base, increase of habitat heterogeneity of dead branches and fallen woods, observation of decomposition constants for different wood qualities, investigation of soil nutrients and animal composition, measurement of microbiota in different stages of decomposition, and data estimation of the overall carbon sequestration of soil and forest



Soil sampling from the mine and the Ark plan venue conducted by the team of Dr. Chiao-Ping Wang, along with instructions to TCC employees for following monitoring and execution



**Scholarship mechanism to cultivate soil professionals**

**/ EXPECTED BENEFITS**

Offer scholarships to cultivate talents in soil environment and biodiversity for the society and the academic circle and raise the public awareness of the significance of soil and biodiversity.



**Industry-Nature Symbiosis for Protected Areas of OECM**

The "30x30 goal" was established on COP15 in 2022: protect 30% of Earth's lands and oceans by 2030. According to the UN Convention on Biological Biodiversity, an OECM can be accounted in the global biodiversity conservation area and included in the scope of 30x30 goal. Therefore, the OECM inventory and certification has become a direction to work for to various countries.

OECM stands for Other Effective Area-based Conservation Measure. According to the Ocean Conservation Administration (OCA)<sup>1</sup>, it is "governance and management in a specific geographical area outside protected area via different methods that render positive and long-term sustainable impacts on local biodiversity and related ecosystem functions and services as well as offer cultural, spiritual, socio-economic, and other local-related values," making it the concept of a "quasi-protected area."

**Four General Criteria for OECM Certification**

- 1 Area is not recognized as Protected Area
- 2 Area is governed and managed
- 3 Long term sustained in-situ conservation of biodiversity
- 4 Associated ecosystem functions and services in line with the Satoyama/Satoumi<sup>2</sup> concept

**The OECM Recognition Standard**

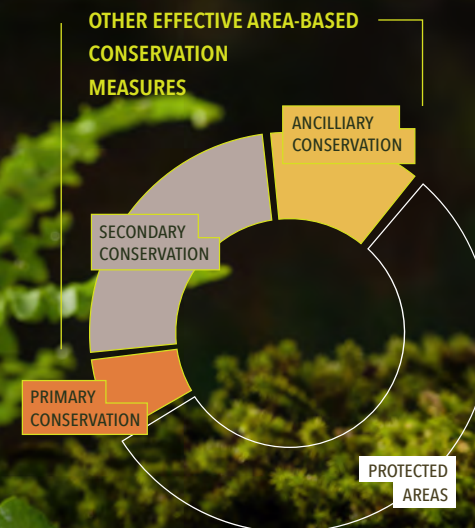
An OECM has to be recognized by the local competent authority. Nevertheless, there are no relevant laws or regulations in Taiwan as to the clear definition and recognition thereof. At present, the OCA and the Forestry and Nature Conservation Agency are working on it. The OECM certification schemes or regulations for lands and oceans are projected to be released successively by the end of 2023.

**The Hoping Port and the Bio Cube Coral Restoration Area**

According to the preliminary assessment of marine conservation scholars, the venues are hopeful to meet the OECM Criteria. In addition to the ongoing high-intensity management and in-situ restoration, TCC also planned to further consult domestic and foreign experts and scholars for the feasibility study of OECM certification, so as to contribute to the marine ecosystem.

**Ho-Ping Ark Ecological Program Experimental Base and the Shoushan Mine in Kaohsiung**

According to the analysis of forestry experts, since TCC owns the land, which is within a clearly defined area, a management system shall be established and continuously improved in alignment with the OECM Criteria.



Note 1: Source: The alternative thinking beyond the marine protected areas -Other Effective Area-based Conservation Measure, Ocean Conservation Administration, retrieved on 2022/4/28. [https://www.oca.gov.tw/ch/home.jsp?id=14&parentpath=0,2&mcustomize=news\\_view.jsp&dataserno=202204280001](https://www.oca.gov.tw/ch/home.jsp?id=14&parentpath=0,2&mcustomize=news_view.jsp&dataserno=202204280001)

Note 2: Satoyama/Satoumi is the living model promoted by the UN Convention on Biological Diversity, with the integration of human's development needs and the natural environment taken into account. It indicates the achievement of the win-win-win in life, ecosystem, and production for the mountains, forests, streams, and oceans surrounding human communities through the proper use by humans to provide diversified habitats for flora and fauna.



### 3.2 | Stakeholder Engagement on Topics of Nature

#### ECO-TOUR

TCC DAKA was open to the public on 9<sup>th</sup> January 2020, disclosing the actions of TCC in a transparent manner and holding multiple activities to interact with different people to convey the spirit of promoting the sustainable development of industry and cities. Through the "3-in-1 Tour of Port, Power Plant, and Cement Plant," the public can go into the Hoping Mine and the Hoping Port to see in person the environmental management and investment in the restoration efforts for the mine and corals as well as the model of circular economy with zero emission, zero pollution, and zero waste. Aligned with the innovative communication model of TCC DAKA, the Hoping Port was certified by the EPA Taiwan as the first port-based environmental education facility on 22<sup>nd</sup> February 2022. The public

《動植物的家》蔡承恩

雲好厚  
霧好濃  
風好強  
雨好大  
石頭也好多……

請問：植物的家在哪兒？  
就在太白山裡！  
請問：動物的家在哪兒？  
也在太白山裡！  
原來，  
它們都是同鄉的。  
台泥的員工們  
正在植生綠化園區裡  
努力打造出綠意盎然、  
熱鬧非凡的家！



Students from Shih Min Elementary School in Yilan presented their reflections on the visit to the Taibai Mountain in a new poem.

can learn about marine conservation and port management through the tour by professional environmental educators and on-site visit. Due to the sensitivity of corals, to narrow the gap between the public and the coral reef ecosystem, the Hoping Port uses anemones, which are also cnidarians and can be regarded as a larger version of corals, for interactive experiences. Visitors can learn about coral ecology by feeding the anemones in the tour. In addition, the Hoping Power Plant of TCC worked with the Coast Guard Administration in 2021 in response to the OCA's policy of Tribute to the Ocean. The space on the first floor of the inspection office by the Hanben Beach, Aohua Village, Yilan County, was revitalized. Group guided tour and "Convenient Beach Cleaning," a beach cleaning equipment loan service, are available as well. In 2023, all the staffs on the station became OCA volunteers, caring for marine conservation and marine debris issues together with travelers.



TCC DAKA Happy Farm



Respect nature, conform to nature



#### Local Tribe Communication

To facilitate the industry-society communication and practice the factory-community coexistence in harmony, TCC actively interacts with local residents via various channels to exercise the philosophy of "factory as classroom." Aside from partnering with local schools and organizations to offer customized itineraries, the Hoping Plant and the Suao Plant would invite local residents from time to time to go into the mountains to learn about the performance on mine restoration. TCC took the initiative to elaborate on the status of its operation and environmental management to local communities, reducing the residents' concerns about the risks for their living environments. For example, in May 2023, the teachers of Yongle Elementary School in Yilan went to the Taibaishan for an eco-tour, during which the Taibaishan Mine Restoration Team guided the teachers through the endemic and indigenous plants successfully restored.



Teachers from Yongle Elementary School in Yilan visited the Taibaishan Mine.

Hualien County in October 2021 for tribal consultation. The tribal consultations and voting procedures were organized on 17<sup>th</sup> and 22<sup>nd</sup> of March 2022, at the Gukut and Knlibu Tribes in the Xiulin Township, respectively. 82.2% of the households in the Gukut Tribe and 97.6% in the Knlibu Tribe approved as the result. In the process of communicating with the tribes, TCC produced a special booklet "For the Future, Make Peace with Sustainability," in which it recounts the fruits of TCC in the circular economy at the Hoping Port and Power Plant as the result of collaboration with the local communities over the past 2 decades and explain the future plan of TCC to transform the designated cement zone into a low-carbon environmental green energy park, hoping to join hands with the Heping Village on the path to a sustainable development of the tribes.



In response to the mining matters of the Hoping Mine (including the Hoping, Baolai, Heshengyuan, and Jinchang Quarries), the Hoping Plant took the initiative to apply to the Xiulin Township Office of



In addition to the customized guided tours conducted by the Taibaishan Mine Restoration Team from time to time, the Suao Plant also organized cement handcraft workshop occasionally, created a Facebook Page [TCC Suao Plant - A Centennial Transformation of Cement Fantasy], and opened the plant for active interactions with local residents. The Suao Plant taps into its century-old history to write the history of cement with Taiwan that combines the cement industry and humanistic features. The plant communicated with Suao on the present and future via diverse activities as well. TCC also initiated the plan for the consultation with the Iyo Tribe.

#### The Happy Farm at the Cement Plant Food waste turned into nutrients that nurture the earth

One third of soil worldwide is degrading. Organic wastes like food waste are made into soil amendment. It not only leverages organic matters in lieu of the chemical fertilizers that consume energy but also return nutrients back to soil to improve soil quality. In February 2021, the Hoping Plant opened the Food Waste Recycle Center. The diners at the tribes send their food waste to the Hoping Plant, which is transformed into soil amendment by the large fermentation equipment for the villagers in the neighborhood to use it in farming at the Happy Farm in the Hoping Plant. The Taibaishan in Suao also actively promotes eco-friendly agricultural research to farm with zero chemical fertilizer, zero pesticide, and zero additive in the manner of co-benefit of crops in symbiosis, which prevents both pests and weeds.







### 3.3 | Guardian of Life on Earth for Good – KBCC

TCC Group has been investing in Dr. Cecilia Koo Botanic Conservation Center (KBCC) for 17 years since 2007. The establishment of KBCC was a fruit stemming from the Confucian demeanor of Mr. C.K. Koo, the late Chairman, who tied the business purpose of the Company with giving back to the society. His spouse, Ms. Cecilia Koo, committed to charity and supporting the disadvantaged, donated 20 hectares of the land in Pingtung for free to establish KBCC and build an ark for the survival of endangered species on Earth.

KBCC mainly collects endangered or rare plants in the tropical and subtropical regions. The footprints of its hunters can be seen in the Southeast Asia, Mainland China, Oceania, Africa, Central and South America, etc. They race against all odds and time in an attempt to rescue the plants close to distinction prior to disappearance of the rapidly destroyed rainforests. The actions have also attracted the attention of media worldwide, including the National Geographic Channel. From the initial 12 taxa of plants such as orchids and bromeliads to the addition of begonias, succulents, aquatics, and mosses, KBCC has accumulated nearly 30 taxa of plants, many of which are the world's best or extinct in the wild. As of 29<sup>th</sup> June 2023, 34,260 taxa of plants from around the world have been successfully cultivated, among which the collections of orchids, bromeliads, begonias, mosses, and ferns are the best in the world. The goal is to preserve 40,000 taxa of plants by 2027, making it the world's most significant sanctuary for tropical and subtropical plants. In addition, cryopreservation of different parts of plants in liquid nitrogen is carried out. There are now more than 4,000 species and 25,000 tissue specimens preserved and available as research materials for the next generation of scientists.

The plant collection mainly features plants that are cultivated in greenhouses.

17 net greenhouses, totaling 35,398 m<sup>2</sup> (about 3.5 hectares). There are also 2 temperature-controlled rooms dedicated to the cultivation of aquatic plants, insectivorous plants, begonias, Arairai, Melastomataceae, etc. All the collections are labeled with barcodes. Just like a digital ID, it allows anyone to check a plant's name, place of origin, and when it entered Taiwan at any time for the ease of research.

#### Animals Conservation Program

In addition to plant conservation, KBCC has been conducting bird conservation since May 2013. To date, it has collected 32 species, including 1 taxon of Gallus gallus, 14 taxa of internationally registered strains, 1 variant, 15 regional strains, and 1 taxon of genetic mutation expression, totally 499 birds as of 30<sup>th</sup> June 2022. In December 2013, commissioned by the Forestry and Nature Conservation Agency, KBCC raised the turtles found in smuggling activities. Thus, the turtle conservation program commenced. There were 430 turtles of 23 taxa in the collection as of 30<sup>th</sup> June 2022.

#### Asteroid No. 526460 –Ceciliakooen

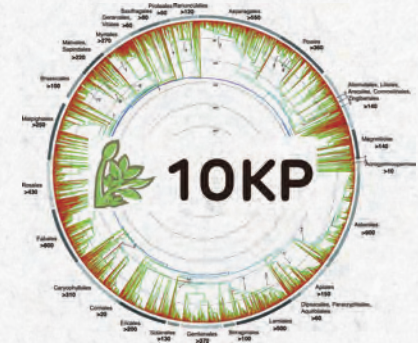
In recognition of the long-term commitment to species conservation and ecosystem sustainability as well as the selfless support to academic research and new drug development programs, the National Central University specifically named the Asteroid No. 526460 found by Lulin Observatory as "Ceciliakooen" officially. Followed by the approval after the review by the International Astronomical Union (IAU), the name was officially registered among the stars in January 2022, signaling the aspiration that the largest tropical plant conservation center on the planet may be the Ark of Plants to sail onward with the hope of sustainability onboard. The Asteroid "Ceciliakooen" shall transform this spirit and shine in the universe for good.



#### Participation in the 10K Plant Genome Sequencing Project

During the 19<sup>th</sup> International Botanical Congress (IBC), BGI Research joined hands with authoritative experts in the field of botany from the United States, Germany, the United Kingdom, and Canada, to initiate the 10,000 (10KP) Plants Project, aiming to sequence the genes of 10,000 critical plants on Earth within five years from 2017. However, the research sampling has been severely impeded due to COVID-19, with only more than 1,000 specimens received from over 50 institutions from more than 20 countries, including Mainland China, USA, UK, France, Australia, and Canada, and nearly 300 plants completing their genome sequencing. KBCC joined the project in January 2022, providing the sources of genetic materials.

The project remains in progress. Through the extensive global partnership, comprehensive resource collection, and systematic scientific design and research, it carries out sequencing and research on the genomes of 10,000 plant species, offering extremely crucial genetic information for the botany science community to promote the application and research on biodiversity, evolution, and ecology.







**Partnership with the Graduate Institute of Natural Products, KMU for the Library of Natural Anticancer Products**

Most of the crucial elements in the development of human medicine come from natural plants. In 2014, KBCC collaborated with Kaohsiung Medical University (KMU) for extraction and establishment of natural product libraries. At present, the plants in the natural product libraries came from 920 taxa across 83 families of plants. A high-throughput screening platform has been established, along with the natural product libraries, to improve the throughput screening services and make the unique resources available to the domestic new drug R&D. Through the mutual collaboration over the past few years, the natural product libraries established more than 2,500 extracts, assisted in the completion of multiple screening projects, and found that the Nepenthaceae and the Musaceae exhibit biological activity against breast cancer, liver cancer, oral cancer, HBV, and influenza viruses, and may even be used in the COVID-19 research, boosting the energy of drug R&D domestically.



Cryopreservation in liquid nitrogen

**Homecoming Project for the Indigenous Species of Lanyu (Orchid Island) Lanyu, formerly known for its orchids, has no orchid today.**

KBCC collaborates with the National Museum of Natural Science, NMNS Foundation, Taipei Zoo, Endemic Species Research Institute, National Museum of Marine Biology and Aquarium, and Taiwan Forestry Research Institute for the feature botanical garden project at the Lanyu ecological base. With plants at the core for ecological research, experimental habitats were selected for relevant species to observe their subsequent development. At present, Nunyu Bletilla (*Bletilla formosana* (Hayata) Schltr. f. *kotoensis* (Hayata) T. P. Lin), *Dendrobium miyakei*, *Tuberolabium kotoense*, and *Vanda lamellata* endemic to Lanyu and in danger of extinction are selected as priority species for restoration, with more than 4000 seedlings have been cultivated. Meanwhile, it is planned to open the natural history exhibition rooms of Lanyu and Xiaolanyu. With the exhibition rooms with specimens at the core, the residents, or the public, can appreciate the collections of natural history of animals, plants, fungi, and rocks on the islands.

KBCC plans to establish research stations and dormitories on Lanyu in the next 2-3 years for researchers to carry out basic works of specimen processing. In addition, simple dormitories shall be built to solve the issues of research supplies and accommoda-

tion. In order to promote the concept of sustainability, this project is connected with the Earth Helper campaign of TCC to replant the endangered orchids that have been successfully restored back to their original habitat, Lanyu, as another way to promote the concept of ecodiversity.



**Partnership with the Institute of Molecular Medicine (IMM), NTHU for Cranial Nerve Repair Drugs R&D**

The Institute of Molecular Medicine (IMM), National Tsing Hua University (NTHU), found in the research that the plant extract of Araceae can be used as a drug for the treatment and repair of cranial nerves, mainly to facilitate the axon regeneration of cortical neurons and hippocampal neurons after traumatic brain injury. Meanwhile, it also verified that the extract has no negative impact on the glial cells. In the future, we will apply for relevant patents with the hope to contribute to the health of humans around the world.

**Drought-resistant Millet Research in Response to Extreme Changes Plan for GIAHS Application**

Featuring drought tolerance and a short life cycle, millet is regarded as a food for famine relief, which has been more emphasized in the face of climate change impacts. KBCC started to work with the laboratory at the National Cheng Kung University (NCCU) and the cultural and creative group in Hualien in 2019 to analyze the millet provenances of Taiwanese tribes and preserve them in liquid nitrogen. The National Sun Yat-sen University partnered with KBCC for the in-depth collection, preservation, classification, research, and promotion of indigenous millet provenances in 2023. At present, taking the indigenous millets for example, there are more than 400 tribes in Taiwan, but

at least 300 tribes no longer grow millet anymore over the past century. The loss rate of provenances of the produce millet is over 75%. This project will apply for becoming one of the Globally Important Agricultural Heritage Systems (GIAHS) as well.



**The Endemic Species of Pingtung "Pyrenaria buisanensis" Returns to Mother Earth Seeds Academy & Endemic Insect Propagation Project of Taipei Zoo**



For more information, please refer to P.62 and 63 of the 2022 TCC Sustainability Report

