Copper Alloy Mesh: Improving Sustainable Aquaculture

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Innovation in aquaculture cages using copper based alloys
铜合金网箱 水产养殖的创新

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Aquaculture trends 水产养殖的趋势

- Global expansion **全球扩张**
- Moving offshore **趋向离岸网箱技术**
- Expanding cultivation of warm water species **热带鱼种养殖不断扩增**
- Increasing pressure for more sanitary, sustainable aquaculture practices **水产养殖急需清洁卫生，可持续发展的产业模式**
- More sophisticated net pen technology **更先进的网箱技术**

Why copper alloys?为什么要使用铜合金

- High resistance to macrofouling
  有效防止生物附着
- Track record in marine engineering
  跟踪记录海洋工程
- Low general corrosion rates **低腐蚀速率**
- High resistance to other forms of corrosion which can lead to early failure
  高抗腐蚀性，避免早期腐蚀
- Strength and rigidity for robust construction **坚固耐用，是理想材料**
- Diversity of fabricated specifications
  制作规格多样

Advantages of Cu alloy cages 铜合金网箱的优势

- Avoids biofouling and the costs, fish stress, and nuisance of net changes
  避免生物污染，降低成本，防止鱼类应激和更换鱼网的麻烦
- Avoids habitat for parasites and pathogens
  抑制寄生虫和病菌的滋生
- Increases water exchange and oxygenation to improve fish health and growth
  增加水体流动和含氧量，有利于鱼类的健康和成长
- Deters predator attacks and prevents escapes
  阻止捕食者的攻击，防止鱼类逃逸
- Maintains cage volume **保持网箱容积**
- Improves feed conversion **提高饲料转化率**
- Lowers discharge to sediments **降低沉积物排放**
- Recyclable**可回收**

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Current ICA activities
国际铜业协会现阶段开展的活动

- Demonstrate effectiveness of various copper alloys in actual fish farm environments in important aquaculture countries with different species **在主要的水产养殖国家中，国际铜业协会（ICA）在各大渔场中安装不同类型的铜合金网箱，以展示铜在水产养殖中的积极效果**

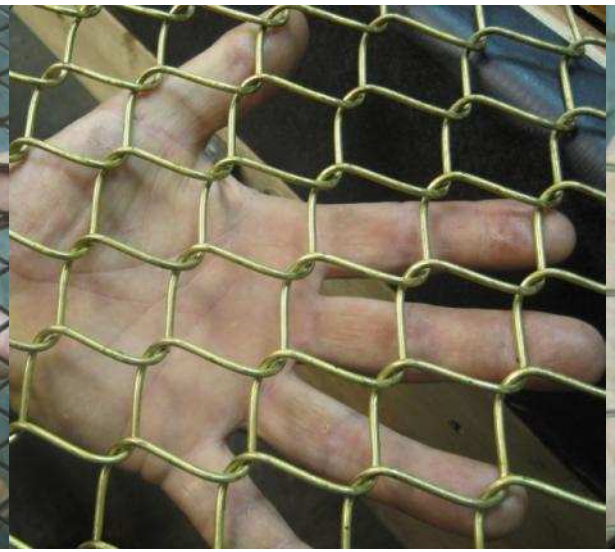
- Establish physical, environmental, productive, and economic performance of copper alloys used in different types of aquaculture cages **检测不同类型铜合金网箱的物理、环境、生产力和经济性能表现**

- Provide practical and scientific evidence that using copper in marine aquaculture improves fish health **提供实用的科学证据，表明铜有助于海产鱼类的健康**

- Enable aquaculture equipment suppliers to use copper alloy mesh with confidence **让水产养殖设备供应商对铜合金网箱充满信心**

Types of copper alloy mesh 不同种类的铜合金网箱

Expanded strip 74% open area, 1mm thick 90/10 Cu-Ni
拉伸网，74%为网目空间，1毫米厚，90/10铜镍合金



UR 30™ chain link mesh, 2.5 mm 65/35 Cu-Zn
UR 30斜方网，2.5毫米65/35铜锌合金

Seawire™ welded mesh, 1.5mm welded Cu-Si
Seawire点焊网，1.5毫米铜硅合金焊接

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Low maintenance nets 维修费用低廉

Some nets have been installed in Japan for over 8 years without net changes, fouling or cleaning. Loss of material due to corrosion is highest in the top 1 meter of the net; submerged nets can extend life.
在日本，一些网箱安装8年以来无需任何更换，保持清洁并不受污染。材料腐蚀所造成的损失在鱼网最高的一米处最为严重，沉降式网箱有更长的使用寿命。

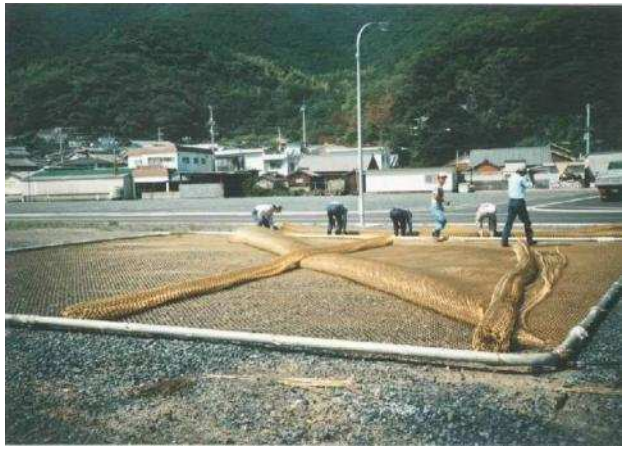
UR30 after 1.5 years
UR30使用1.5年后的情形

UR30 after 2.5 years
UR30使用2.5年后的情形

Japanese technology日本技术

Typical Sizes常见尺寸

- 10m x 10m x 12m
- 20m diameter



28 salmon cages at Van Diemen aquaculture in Tasmania在 塔斯马尼亚的凡迪门水产养殖场的28个三文鱼养殖笼

Ashimori Industry Company and Mitsubishi-Shindoh have used this location to develop and evaluate improved UR30 materials and new cage designs. Site in estuary has extreme conditions of reversing high velocity currents, salinity gradients, and high summer water temperatures. Salmon are raised without the use of antibiotics.

芦森工业公司和三菱在这里发展和评估改进之后的UR30材料。河口位置水流湍急，高盐度梯度，夏季水温较高。在这里饲养的三文鱼没有使用抗生素。

Retrofit/new applications 改造/新应用

Existing cages and new cage designs can be improved with copper alloy mesh. 可以用铜合金网箱改善现有以及新的网箱设计。

Replacement opportunity 更换机会

Round HDPE cage高密度聚乙烯环形网箱

Square steel cage 方钢笼

Square steel cage w/ platform
方钢笼瓦特/平台

New approaches 新方法

Ocean Spar 3000 submersible cage
Ocean Spar 3000型沉降式网箱

OCAT cage with copper mesh OCAT铜网箱

Aquapod 3600 cages
Aquapod3600型网箱

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EcoSea farming 生态海水产养殖

- Start-up company created in Chile by ICA in 2007
  公司由国际铜业协会于2007年在智利创建
- Transferred know-how from Japan to Chile
  技术由日本转移到智利
- Provides fish farmers with UR30 aquaculture cage systems
  为水产养殖户提供UR30养殖网箱系统

EcoSea rapid assembly and installation method
智利生态海公司快速组装和安装方法

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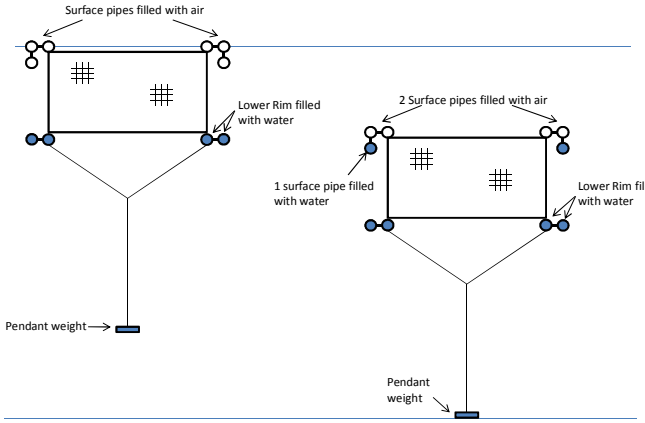
EcoSea submersible cage for exposed conditions
露天环境下的生态海潜水网箱

Submersible cage 20 meters in diameter designed with University of New Hampshire experts as part of a project co-funded by the Chilean government. Evaluating hydrodynamic, structural and antifouling response.

图示潜水网箱由新罕布什尔大学的专家设计，直径20米，项目部分资金由智利政府赞助。它可用以评估水动力，检测结构和防污反应。



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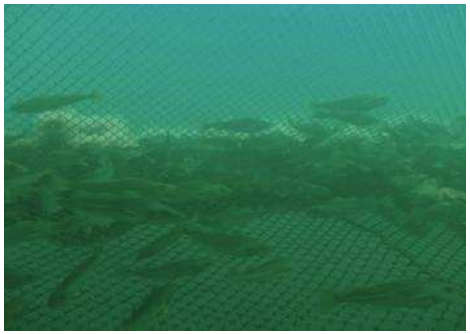
North Atlantic cod trial 北大西洋鳕鱼试验

OCAT cage with UR30 mesh fabricated in the USA. Normally submerged 10 meters below surface. Note extreme fouling on plastic structure and absence of biofouling on copper alloy after 4 months. Cage survived hurricane. Cod did not bio-accumulate copper and were in excellent health.

下图为美国出产的UR30铜合金OCAT网箱。通常，网箱浸没在水面下10米。使用4个月后，在塑料的构架上出现严重污染现象，而铜合金网箱上则没有此情况出现。此网箱可以承受台风侵袭。鳕鱼体内没有出现铜积累，生长健康。



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Ocean farm technology 海洋养殖场技术

Night assembly of Aquapod at Open Blue Sea Farms, Panama for trial 11km offshore with cobia. Three Aquapods are installed, each with a different form of copper alloy mesh.

在巴拿马的露天蓝海渔场，夜间组装Aquapod，在11公里外的军曹鱼试验网箱效果。安装的三个Aquapod网箱使用了不同的铜合金网衣。

Aquapod installation 安装Aquapod铜合金网箱




Marine cage aquaculture in China 中国海洋箱网养殖

- 20% of global marine production
  20%的全球水产产量
- About 1 million small cages filling all available sheltered coastal locations
  约100万的小网箱安装于所有渔业养殖的海岸地区
- 100 m^3 typical cage size
  常见网箱的大小为100立方米
- Diseases spread between fish cages crowded in near-shore locations
  近岸鱼笼间易传播多种疾病
- Existing cages are not strong enough for more exposed conditions
  现有网箱尚不能承受各种外界自然条件
- Currently developing range of copper alloy mesh cages for near-shore and offshore conditions **目前正在开发用于近岸和离岸条件下的各种铜合金网箱**
- Main project partner is ECSFRI – East China Sea Fisheries Research Institute **主要项目的合作伙伴是ECSFRI - 东海水产研究所**

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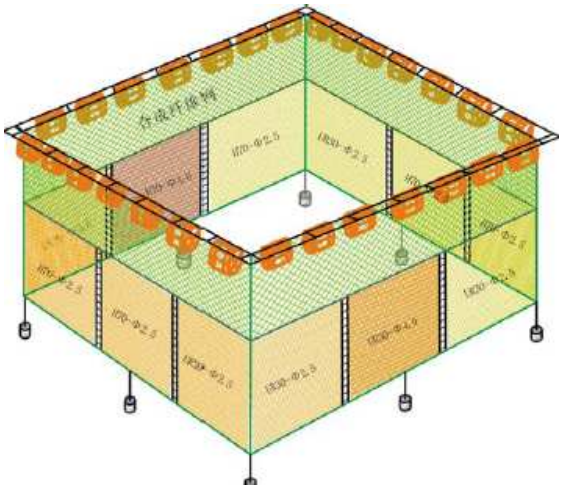
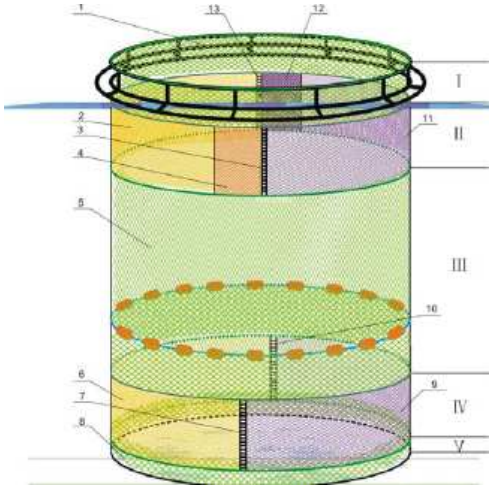
Cage and mesh testing at ECSFRI
在ECSFRI进行网箱测试



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Conclusions 结论

- First steps taken to make copper alloy cages a global commercial reality
  铜合金网箱实现并具有全球性的商业价值
- UR30 (Cu-Zn) already established; Cu-Si and Cu-Ni being evaluated
  UR30（铜锌合金网箱）已经成功研发;铜硅合金与铜镍合金正处于检测阶段
- Innovative cage designs suited to copper alloy cages being tested
  创新性的铜合金网箱设计正在测试当中
- Resistance of cages to fouling and corrosion demonstrated
  铜合金网箱具有抗污染，耐腐蚀的特性。
- Improved fish health and growth demonstrated; monitoring on-going
  应用铜合金网箱可有显著提高鱼类健康；长期检测。
- Feedback to date successful; future results of trials will be reported
  迄今为止得到的反馈相当积极，并将随时更新检测报告结果。

A better technology for fish farming

First steps taken to bring copper alloy cages into use in China

- Copper alloy materials for aquaculture cages are available in China
- Resistance of cages to fouling and corrosion demonstrated
- Innovative cage designs suited to copper alloy cages being built and tested by Chinese industry
- Expecting same improved fish health and growth in China as demonstrated in Japan, Australia, and Chile
- Opportunity to create better living conditions for fish; better profits for fish farmers; better quality fish for people

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