Executive Summary

Rose Canyon

FISHERIES

EXECUTIVE SUMMARY

Rose Canyon Fisheries, Inc. (RCF) is a partnership between Hubbs-SeaWorld Research Institute (HSWRI), a 501(c)(3) research organization, and Cuna del Mar (CdM), a private equity fund dedicated to developing sustainable aquaculture. RCF will permit, establish and operate a commercial-scale fish farm off the San Diego, CA coast. This will be the first operation of its kind in federal waters of the United States. By combining the scientific and environmental expertise of HSWRI with the mission focus and direct open ocean aquaculture experience of Cuna del Mar, RCF will help pioneer environmentally and economically sustainable methods for providing healthy seafood to meet our Nation's growing demand for healthy seafood.

CdM and HSWRI through RCF share a vision to feed future generations in harmony with the ocean. The RCF collaboration is dedicated to fulfilling a major void in our Nation's seafood industry – a reliable, sustainable source of healthy, premium fish, grown with care in a clean, natural and regulated environment. RCF is committed to improving the standards of the aquaculture industry through safe and sustainable innovation. As RCF continues to innovate and improve culture protocols, it hopes to provide locally produced seafood thereby greatly reducing the energy requirements of transporting fish to the US market, while creating and demonstrating a sustainable and domestic solution.

Over the past five decades, HSWRI has provided global leadership in marine conservation research, including studies in marine aquaculture. HSWRI operates two marine fish hatcheries in southern California and several cage sites in California. HSWRI has expertise in fish nutrition, reproduction, health, genetics, and physiology, as well as site selection and permitting, systems engineering, and environmental monitoring.

Since 2010 CdM has been advancing the development of sustainable marine fish farming by providing investment capital to expand established and start-up farms in Latin America as well as to further develop open ocean marine farming equipment. CdM has financial and management interests in shellfish farms on the Pacific Coast of Baja California as well as in fish farms in La Paz, Mexico and along the Gulf Coast of Panama. CdM has like interests in two US based companies that design, fabricate and install open ocean marine fish cages.

Together, HSWRI and CdM have formed RCF that incorporates the combined expertise of both organizations to demonstrate how a commercial scale fish farm can provide new job opportunities for commercial fishermen and support existing seafood processing and distribution jobs while respecting the environment of southern California. The proposed farm will also provide an invaluable benefit to resource agencies charged with balancing commercial uses of the ocean with the need to conserve the invaluable marine ecosystem for the benefit of future generations of both animal and human populations.

This project is being driven by the growing global demand for healthful seafood and a lack of domestic production. Traditional harvest fisheries are fully exploited and cannot meet this increasing demand. The expanding market is fueled by an increasing world population and the growing per capita consumption of seafood. In the US, more than 91% of seafood is imported and half of that supply comes from aquaculture. This represents a $10.4 billion contribution to the US trade deficit.

APPENDIX V. YELLOWTAIL JACK *(SERIOLA LALANDI)*

Fishery Information

Yellowtail sport and commercial fisheries have been off the coast of California since the end of the 1800s. Originally using handlines, commercial fishing transitioned into hook-and-line fishing in 1898 at Santa Catalina Island. The current range of the fishery is restricted to waters south of Point Conception. Until 1933 the commercial fishery was restricted to live bait boats off southern California to Baja California, Mexico. After 1933, purse seiners were only allowed south of the Mexican-American border due to the decline of the yellowtail in California waters. Gillnet boats began incidental landings of yellowtail while fishing for white seabass. This continued until 1994 when nearshore gillnetting was banned leaving only hook-and-line fishing or farshore (greater than three miles) gillnets.

The commercial landings of yellowtail have ranged from 11.5 million pounds (1918) to just under one thousand pounds (1995). These landings fluctuate with water temperature as well as commercial demand. Beginning in the 1950s, private boaters began taking a significant number of fish, sometimes more than commercial passenger fishing vessels.

Maturity and Reproduction

Yellowtail are fast growing, gaining about three to four pounds per year. The largest recorded weight was 80 pounds. Typical weight for landings in southern California and the Coronado Islands are four to twelve pounds, twelve to eighteen in Baja California. Using gillnets, commercial catches range from ten to twenty pounds and four to twelve pounds for commercial hook-and-line fishermen. Yellowtail spawn during the summer, June through September. Both males and females move offshore to form spawning aggregations during the spawning season. All females over three years old are capable of spawning and sometimes at two years old. A twenty pound fish is capable of producing over 900,000 eggs in one spawning season.

Aquaculture

A transitory, seasonally abundant species in southern California, yellowtail are valued as both a game and food fish. They are highly prized in the sushi markets and sold as hamachi. Captive broodstock are held at HSWRI's research facility in Mission Bay, San Diego under ambient conditions and provide eggs in the spring and summer. HSWRI has conducted growout and marketing trials on this species. Preferred market size is 3-4 kg (6-9 pounds). Their production cycle can range from 24-36 months, depending on water temperature.

Cultured yellowtail for the hamachi and sushi markets is approximately a 160,000 metric ton global market, with 99% of production from Japan. Currently all cultured yellowtail used in sushi markets, including the US is farmed. RCF's proposed production will represent 3% of global production when the farm is fully built out, and will not compete with the local wild fishery, only with foreign imports.

Rose Canyon
FISHERIES

For more information, please contact Rose Canyon Fisheries at
info@rosecanyonfisheries.com.

The proposed project will annually produce 5,000 metric tons (MT) of yellowtail jack, white seabass and striped bass in sea cages that will be located 4.5 miles (7.2 kilometers) from the San Diego shoreline. Yellowtail jack has been chosen as the initial species as cultured juveniles are readily available from HSWRI hatcheries. The site will also be permitted for other local species which will be interchangeable with yellowtail jack when the project has become operational and depending on availability of juveniles and permit conditions. Production will be phased, beginning at 1,000 to 1,500 MT in the first production cycle in order to achieve operational efficiency and ensure environmental compatibility. Based on these data, the project will gradually expand to 5,000 MT annual production, which is expected by year eight. Initially, recently developed submersible cages will be deployed, but the farm will have the capacity to test new containment systems as they are developed over time.

If successful, this project will serve as a model for the development of offshore aquaculture in California and the United States. It will create jobs, including new opportunities for commercial fishermen, and it will ensure that the existing infrastructure for fish processing and distribution has a viable future. The consumer will benefit from a year-round supply of high quality seafood that is safe and healthful. The environment will benefit as a high quality seafood source is produced significantly more efficiently than capture fisheries or land-based practices can achieve. In addition, the supplemental supply of high quality farmed fish will take pressure off wild fisheries.

PROJECT NEED

A growing demand for seafood is being fueled by growing human populations and increasing awareness of its health benefits. Capture fisheries are at or near their maximum production with many fisheries becoming depleted. Increased worldwide demand for seafood can only be met by increased production from aquaculture (Figure 1). This is recognized in many parts of the world; aquaculture production has increased in Japan, Europe and Asia in recent years. By comparison, the United States has delayed development of marine aquaculture, resulting in a steady increase in seafood imports, which now exceed $10 billion annually and represent 91% of total seafood consumption. Yet, despite what appear to be inevitable future pressures on seafood supply, global expansion of aquaculture in freshwater and nearshore marine waters is now limited by competition with other users, poor water quality in some areas, and environmental activism. In the US it is further hampered by a poorly delineated permitting process and lack of experience on the part of regulatory agencies. This project hopes to resolve these limitations.

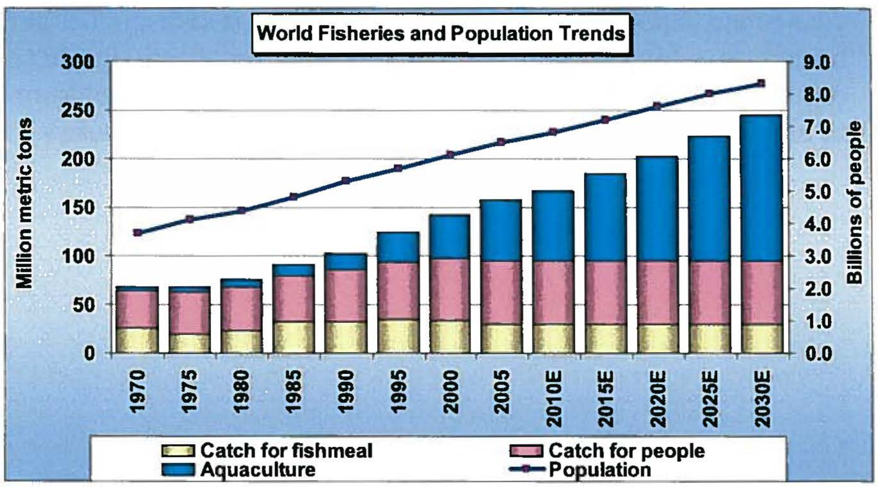


Figure 1. Trends in world fisheries, aquaculture and human population
(Courtesy Chu & Anderson, NOAA pers. comm)

This has prompted efforts in the US to try to develop aquaculture away from the coastline, where water quality is better and conflicts are fewer. In the US there is a drive to develop aquaculture in federal waters, or the US Exclusive Economic Zone (EEZ), consisting of ocean waters 3 to 200 miles from the coastline. The call for these efforts began over 30 years ago when US Congress passed the National Aquaculture Act of 1980, and has more recently been supported various Aquaculture Plans and Policies developed by the National Oceanic and Atmospheric Administration (2006-2011). This effort is in recognition of the need to develop offshore aquaculture and of technological advances in the industry that now make this possible. This acknowledged need combined with the technology now available provides the basis for this project.

PROJECT TEAM

Hubbs-SeaWorld Research Institute (HSWRI) is a non-profit research foundation established in 1963. The Institute's mission is to *"return to the sea some measure of the benefits derived from it."* In the past five decades, HSWRI has provided global leadership in marine conservation research including extensive studies in marine aquaculture, which has been a core program for more than 35 years.

Figure 2. HSWRI hatchery in Carlsbad, CA for rearing white seabass.

HSWRI is a national leader in the hatchery production of marine finfish and operates a production-scale hatchery in Carlsbad, California capable of rearing millions of fingerling white seabass per year (Figure 2). This is a cooperative program with the California Department of Fish and Wildlife, with all seabass produced being released into the ocean to replenish wild stocks. Each fish has to meet the highest standards of quality in terms of appearance, health and genetic diversity. HSWRI also operates a research-scale hatchery in San Diego for rearing other commercially valuable species – both for replenishment and marine farming. Both of these hatchery facilities use state-of-the-art, energy efficient life support systems and are operated to comply with California's rigorous permit requirements.

Figure 3. White Seabass (*Atractoscion nobilis*)

HSWRI has also worked with cage systems for growout of juvenile fish since 1991. In 1997, HSWRI received a federal grant to expand its work by establishing a four-cage system off Santa Catalina Island where white seabass were grown to a weight of 1kg (2.2 lbs) before being harvested and test-marketed. The results were encouraging and significant market potential was recognized. HSWRI also operates two other cage systems and coordinates the activities of twelve other volunteer-based growout facilities in southern California for replenishment of white seabass stocks.

In 2007 HSWRI began an offshore aquaculture project in collaboration with Mexico's largest bluefin tuna farm, Maricultura del Norte, in Ensenada, Baja California, Mexico, approximately 96 km south of San Diego. This project evaluated two species of marine fish – yellowtail jack and striped bass, as well as two different cage designs. In 2010, HSWRI expanded upon this work evaluating soy based diets for yellowtail jack and white seabass with Pacifico Aquaculture off the coast of Ensenada on their Todos Santos Island site.

RCF understands the need for increased production from ocean farms to meet worldwide demand for seafood and to alleviate fishing pressure on wild populations. RCF intends to conduct research and development to fully test the viability of commercial-scale aquaculture in the offshore environment.

This will begin with a commercial fish farming project that builds on over 50 years of marine conservation research at HSWRI, including nearly 30 years on the production of fish in net pens. The demonstration project promises immediate commercial viability, which will make it possible to attract the investment necessary to develop the farm and supporting infrastructure in southern California. Once this is in place, however, RCF plans to use the farm site to develop related aquaculture activities around the farm, such as mussel and seaweed culture, that will seek to integrate production from both operational and environmental standpoints.

HSWRI and CdM have experience in a wide range of aquaculture research and development that will be valuable in the execution of this project (see Appendix I). In summary, they have established or developed expertise in the following areas:

1. Hatchery methods including broodstock management, larval rearing and live feeds production
2. Offshore cage farming methods including transportation of fish and operation of both surface and submersible cages
3. Fish health
4. Nutrition
5. Physiology
6. Reproduction
7. Fish marking, tagging and tracking
8. Genetics
9. Site selection and permitting
10. Environmental monitoring
11. Hatchery and farm systems design and engineering
12. Developed methods for raising several marine finfish species as part of programs to examine the potential for wild fishery replenishment and/or commercial farming

Cuna del Mar is a US based investment firm that explores, supports and develops open ocean aquaculture methods that are economically viable as well as environmentally sustainable. CdM creates opportunities for development and use of innovative technologies that provide solutions to working in the open ocean environment. CdM seeks investment opportunities with early stage companies and to develop new business opportunities. CdM plays an active role in the business of all of its portfolio companies by providing financing, governance and advisory services.

PROJECT SCOPE

The proposed project will apply a scaled or phased approach to develop a fish farm in the US Exclusive Economic Zone (EEZ) offshore of southern California to produce a maximum of 5,000 metric tons (MT) per year of yellowtail jack or other species to be sold in the United States. The project is phased to scale up incrementally with a steady state of production from approximately eight years and beyond. A clearly defined expansion of farm capacity would be allowed after an appropriate environmental evaluation is completed. Initially the farm will be stocked to produce up to 1,000 to 1,500 MT of product at peak harvestable biomass. The farm will operate in this capacity while all aspects of production are closely monitored and documented. Demonstrating the efficacy of the venture at the initial scale of production will ensure that all the proper safeguards are in place before scaling up further. The driving force and timeliness of the plan stem from several key business considerations:

- US demand for seafood from aquaculture is growing rapidly as demand cannot be met from neither domestic harvests nor existing farms.
- All species proposed for this venture are regionally important species to California with well established markets.
- HSWRI and CdM are national leaders in the technology for producing marine finfish – both at sea and on land.
- Equipment is now available that makes farming possible in unsheltered waters off the southern California coast.
- HSWRI's reputation as a responsible marine research institution and steward of the marine environment will ensure that the venture is managed properly.
- HSWRI and CdM collectively have an outstanding team of aquaculture specialists and advisers who are well qualified to implement the project.
- The waters off southern California offer possibly the best marine growing conditions for yellowtail jack and other temperate water marine fish, as well as mussels and seaweeds.

Inherent in the project design is the ability to assist government regulatory agencies and the lay community in developing national aquaculture guidelines through extensive, proactive monitoring and reporting programs. Increased initiatives at the national level, increased demand for seafood and commercial enterprise development are all driving forces that will help to expand aquaculture into the offshore environment. The operational knowledge gained from this project will be directly applicable and serve as a model for the responsible development of sustainable offshore aquaculture in the US.

PROJECT APPROACH

The proposed project will grow yellowtail jack (*Seriola lalandi*), or other local species such as white seabass and striped bass, one species at a time in open ocean cages 4.5 miles (7.2 km) from shore. The resulting seafood products will be available in the freshest form possible, on-demand, and with an assurance of quality unavailable from a harvest fishery or foreign aquaculture. Yellowtail jack has been chosen as the initial species as cultured juveniles are readily available from HSWRI hatcheries. Hatchery technologies do exist for all the other species and as the project progresses, these species will be integrated into the project. Once the project is operational, future considerations could include use of the farm site to develop related aquaculture activities around the farm, such as shellfish and seaweed culture that will seek to integrate production from both operational and environmental standpoints.

The project will employ state-of-the-art cages, nets, and mooring systems. These types of cages are proven technology in exposed environments, used globally and are commercially available. However, as technologies for offshore aquaculture continue to advance, the project will be flexible enough to incorporate any new systems or other technologies that improve production efficiencies in the offshore environment. It will also create jobs, including new opportunities for commercial fishermen, and it will ensure that the existing infrastructure for fish processing and distribution has a viable future. The project will also serve as a research platform for work with project collaborators, including, but not limited to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the National Ocean Service (NOS), the National and California Sea Grant programs, the Western Regional Aquaculture Center and other US and international universities.

Site Description

The proposed project location is approximately 4.5 miles (7.2 km) west of Mission Bay in San Diego, CA (see Figures 4 – 6), the center of which is at Latitude 32°44.469'N, Longitude 117°19.931'W. A variety of criteria were used in selecting the site, including depth, currents, temperature, bottom sediment type and habitat, proximity to shore based infrastructure, and avoidance of areas that would result in any potential user conflicts (other commercial and recreational activities). HSWRI consulted with representatives from a variety of stakeholder groups, and collected and analyzed sediment samples, and used a bottom and depth sounder across the entire site location to ensure that there was no hard bottom or other habitat in the proposed area. This and other site and species information will be used by NOS (National Ocean Service), Science Systems Applications, and CA Sea Grant for integration into an updated proprietary modeling program, AquaModel to simulate water and sediment quality effects of the proposed farm. HSWRI will also be redeploying their Acoustic Doppler Current Profiler (ADCP) to collect more current site information and for a longer duration. Further, the proposed site is being evaluated by the Bren School of Environmental Science and Management at the

University of California Santa Barbara to analyze siting criteria for an aquaculture marine spatial planning project supported by the Sea Grant program.

In summary, the proposed location may be characterized as exposed, deepwater coastal shelf remote from sensitive habitats such as nearshore kelp beds, rocky, hard bottom substrates, seal or sea lion haul outs, or other aquatic resource areas. The area is also remote from islands, seamounts, hard bottom habitat, and any other abrupt changes in bottom bathymetry, as well as away from usual navigational lanes.

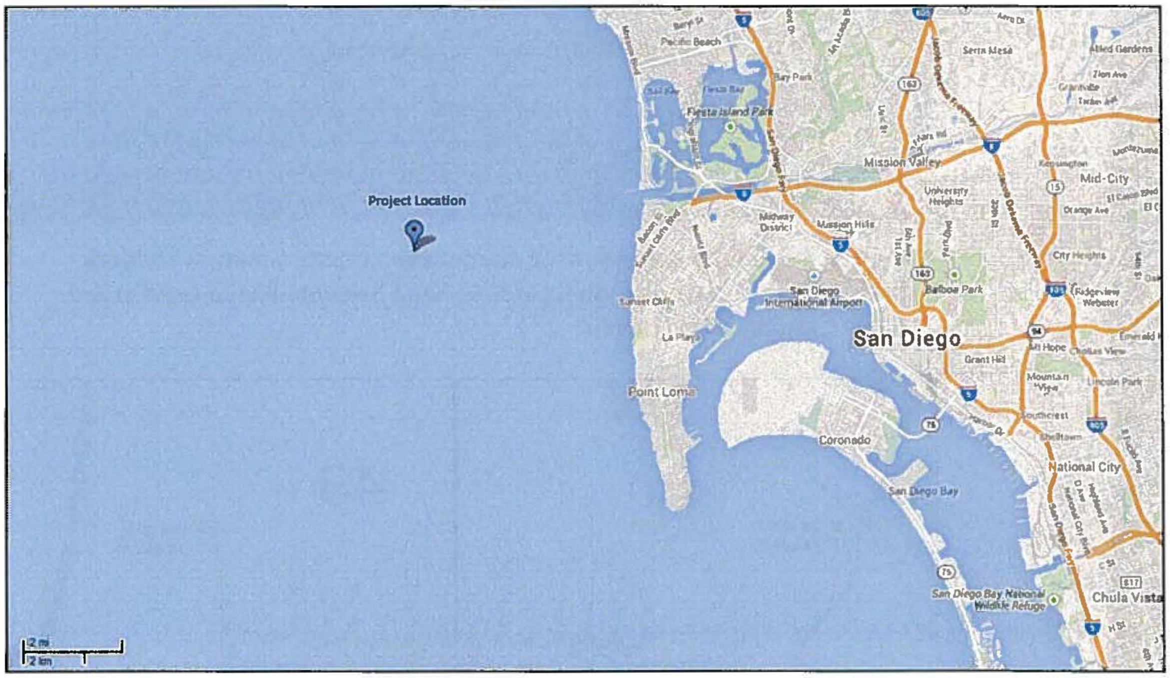


Figure 4. Map of project location.

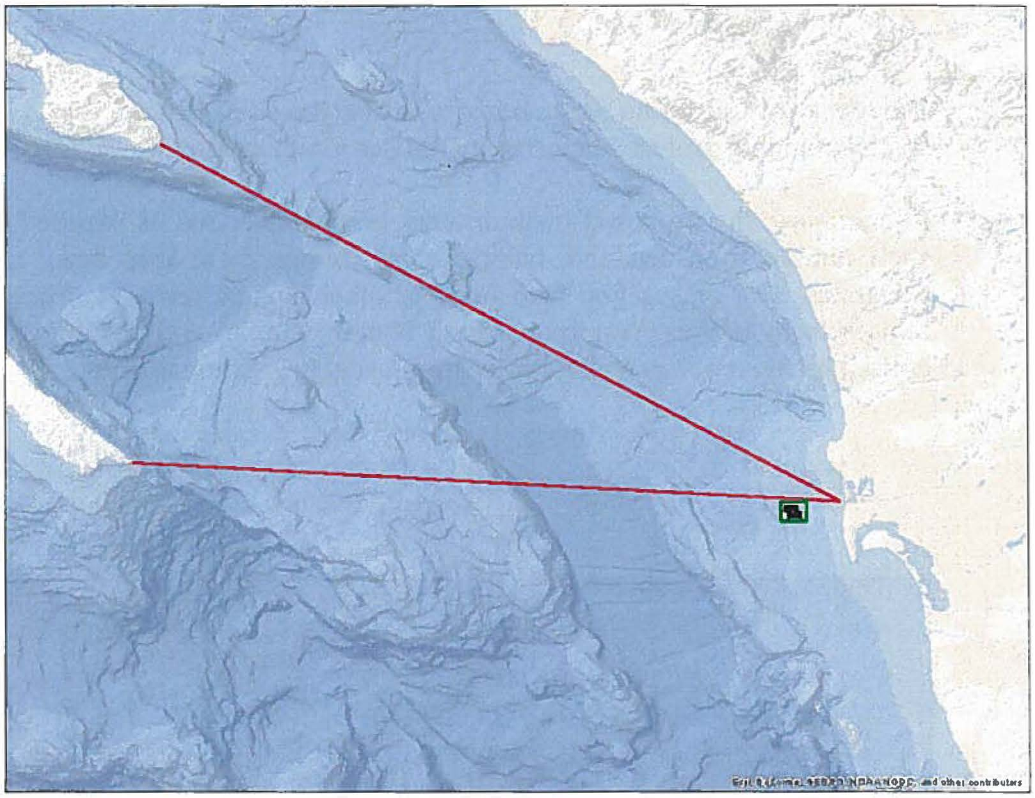


Figure 5. Vicinity map showing site location (green square with black center) and main navigational paths to San Clemente Island (south) and Santa Catalina Island (north).

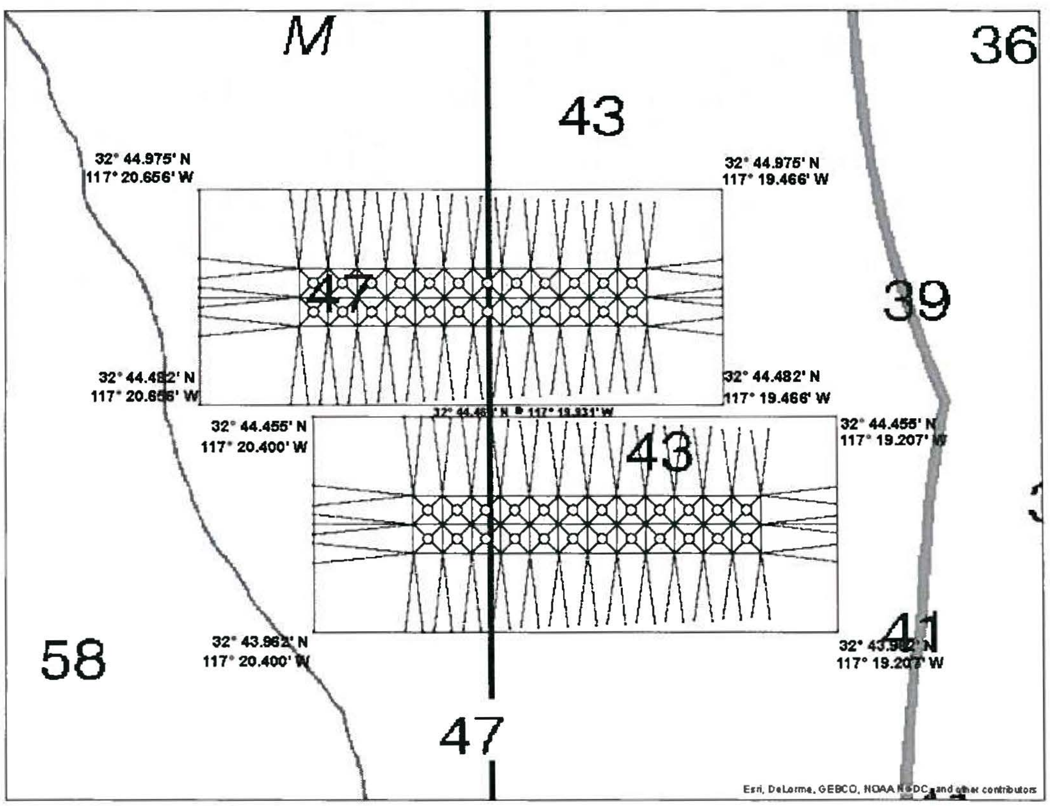


Figure 6. Close up of vicinity map with depths in fathoms.

Culture Systems

Cage Types. Three types of cage systems may be used for this project: Double Rim SeaStation or traditional SeaStation, traditional gravity type surface cages, and Aquapod submersible fish cages.

Double Rim (DR) SeaStation and traditional SeaStation fish cages are designed for large-scale submerged or surface operations in medium-to-high energy open ocean sites (Figure 7 and 8). SeaStation's patented, central spar design provides excellent sea-keeping abilities in open ocean conditions and through major storm events. Cages are constructed with a galvanized steel framework, surrounded with an option of different netting materials, depending on the operator's preference. In other parts of the world these cages have been installed and are currently being operated at commercial production levels. RCF proposes using 11,000 m^3 cages and increasing the number of cages being used incrementally to a maximum of 24 cages per mooring grid.

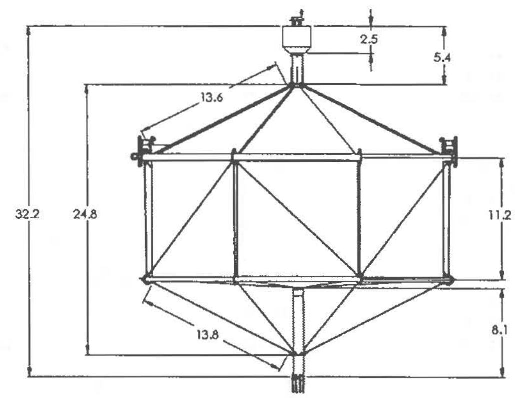


Figure 7. Illustration of a traditional SeaStation DR fish cage

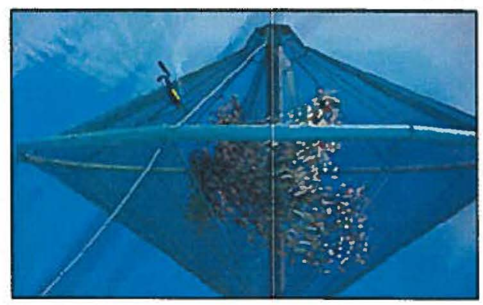


Figure 8. Illustration of traditional SeaStation cage

The Aquapod submersible fish cage is a unique containment system for marine aquaculture, suited for rough open ocean conditions and a diversity of species (Figure 9). The Aquapod is constructed of individual triangle net panels fastened together in a spheroid shape. Most Aquapod net panels are made of reinforced high density polyethylene with 80% recycled content and covered with coated galvanized steel wire mesh netting. Individual net panels or groups of panels are modified to accommodate other functions, such as access, feeding, fish transfer, grading, and harvesting. The Aquapod functions as a secure containment system for finfish while submerged or partially surfaced.

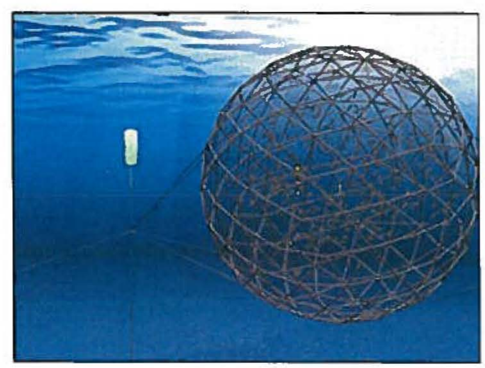


Figure 9. Illustration of Aquapod submersible fish cage

A traditional gravity cage consists of a single or double ring collar made of high-density polyethylene (HDPE) pipe (Figure 10). The pipe is filled with closed cell flotation with a net suspended from the collar. HDPE type or steel type stanchions are installed at intervals around the ring to reinforce the pipe structures as well as support net systems, handrails and walkways. All cage equipment, including navigational aids are supported directly by the flotation structure. Gravity cages come in a wide range of sizes and associated volumes. This project will initially use gravity cages of up to 11,000 m^3 each and will incrementally be scaled to a maximum use of 24 cages per mooring grid, depending and in conjunction with the other cages.

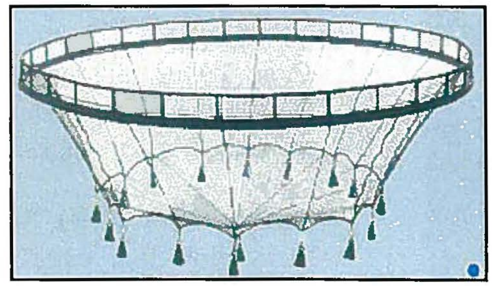


Figure 10. Illustration of a traditional gravity cage design.

Cage netting. Proposed nets and associated mesh sizes are standard in the industry, both in the U.S and throughout the world. For gravity type cages, each cage will have two types of nets; a primary net, which serves as the main containment net for the fish, and an anti-predator net, which acts as a barrier to the primary net and keeps predators at a safe distance (1 m) from the fish being cultured. All nets on gravity cages are weighted from the bottom. This keeps the nets taut so the desired culture volume is maintained and so animals do not become entangled. Primary containment nets will be suspended to a maximum depth of 12 m, with mesh sizes ranging from 0.95 to 2.85 cm square, depending on size of fish being cultured. Predator nets will be 8 cm square mesh and extend below the primary nets by a minimum of 1 m, and also above the cage collar by 2 m. Cover nets, or bird nets of 2.5-5 cm square mesh will also be stretched taut over the cage surface. These nets will be of high visibility color and supported with floating net rings to prevent birds from weighing down the net to the water surface.

Other types of cage netting may also be incorporated into the project, depending on the system used. These netting types can offer advantages over traditional netting in terms of strength and resistance to predators and biofouling.

Kikko Net mesh material is a Tetron plastic wire that can be molded into a variety of mesh sizes. Kikko Net is lightweight (1/6 the specific gravity of iron wire net); heavy strength to prevent continual tears because the structure is constructed using a special knitting method; anticorrosive; resistant to chemicals and sea water, highly resistant to acids. This makes Kikko Net ideal for usage in the sea. The strong material acts as its own predator exclusion mesh. The nets are environmentally friendly as no harmful materials are included in the raw material, and nonconductive to electricity. Additionally, because Kikko Net is non-fibrous, fouling does not grow into the material itself making it easier to clean than standard woven fish netting.

Copper mesh material is used frequently now on a variety of farming operations. Although heavier than traditional woven fish netting and Kikko Net (requiring a more buoyant cage support system), copper alloy's resistance to fouling and strength make it an attractive option. In addition, copper netting resists storm damage and lasts longer than traditional netting, reduces predator attacks and fish escapes, stays naturally clean, reduces drag and maintains cage volume, decreases impact of pathogens and parasites, supports sustainable fish farming and is 100% recyclable and minimizes maintenance cost and efforts.

Mooring systems. One of two mooring grids capable of accommodating up to 24 cages each will be installed before installation of the first cages in order to optimize efficiency and cost. The primary portion of the mooring grid is submerged between 3 to 5 m below the surface and consists of professionally engineered anchors, chain, ropes, and assorted flotation structures. The grid and assembly is designed and installed using site-specific criteria such as depth, current, and bottom type. The final installation of the mooring grid will be perpendicular to the prevailing current direction in order to maximize flow of fresh seawater through the entire system. The cage equipment manufacturers as well as licensed maritime contractors will specify all mooring system configurations. Cage moorings will be inspected at regular intervals and after storm events. Plan and elevation view drawings of mooring configurations, as well as a site map are shown in Appendix II.

Culture Species

All of the species proposed for this venture are regionally important to California with well established markets. Yellowtail jack has been chosen as the initial species as cultured juveniles are readily available from HSWRI hatcheries. The site will also be permitted for other local species such as white seabass, and striped bass which will be interchangeable with yellowtail jack when the project has become operational and depending on availability of juveniles and permit conditions.

Yellowtail Jack (*Seriola lalandi*)

A transitory, seasonally abundant species in southern California, yellowtail are valued as both a game and food fish. They are highly prized in the sushi markets and sold as hamachi. Captive broodstock are held at HSWRI's research facility in San Diego under ambient conditions and provide eggs in the spring and summer. HSWRI has conducted growout and marketing trials on this species. Preferred market size is 4 kg. Their production cycle can range from 24-36 months, depending on water temperature.

Figure 11. Yellowtail Jack (*Seriola lalandi*)

White Seabass (*Atractoscion nobilis*)

This species has been evaluated as a primary candidate for stock replenishment since 1983. Four groups of captive broodstock are held at the HSWRI hatchery in Carlsbad under controlled conditions to provide eggs year-round. HSWRI has conducted release, growout and marketing trials on this species. Minimum market size for this species is between 1-2 kg. Their production cycle can range from 24–36+ months depending on water temperature.

Figure 12. White Seabass (*Atractoscion nobilis*)

Striped Bass (*Morone saxatilis*)

Striped bass have a long culture history in the US, dating back to 1884. By the early 1970's, significant advances in hatchery technologies supported numerous hatchery facilities across the U.S for stock replenishment purposes. Many of these hatcheries now support the commercial culture of striped bass and striped bass hybrids in the US. Market size for this species is between 1-2 kg. Their production cycle can range from 24–36 months depending on water temperature.

Figure 13. Striped Bass (*Morone saxatilis*)

Daily Operations

Fish will be fed several times per day with a pellet feed that is customized for each species under culture. The customization is designed to optimize the health and growth of the fish with the following critical considerations: 1) the nutritional requirements of the fish, 2) the conversion efficiency [food converted to fish flesh] to minimize the waste of feed, and 3) the cost of ingredients to maximize profits. The size of feed is increased incrementally as the fish grow. Use of alternative sources of protein to replace fish meal in the diets is a priority, and finishing diets may be used to adjust the flesh quality to match consumer preferences several months prior to marketing. Automatic feed blowers and feeders are used to dispense the feed to the fish. Observations of feeding behavior (direct from surface and underwater video) are used to continuously adjust the amount of feed dispensed each day so that feed is not wasted. Divers will also perform daily cage and system inspections. At regular intervals (typically every six weeks) throughout the production cycle, a sample of fish from each cage will be weighed and measured to track growth performance (biomass, feed conversion ratio, etc) and to perform routine fish health inspections.

Harvesting, Handling, and Packaging

Fish produced by the project will be harvested fresh weekly. Fish will not be processed beyond whole or gilled and gutted product within project infrastructure, but delivered by boat to shore and transferred to fish traders, brokers, wholesalers, or other pre-determined fish distribution outlets. The fish will be transported in insulated fish totes filled with a slurry of ice and brine. RCF will work with the State Department of Health Services (SDHS) and the United States Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) to develop an appropriate Hazard Analysis and Critical Control Point (HACCP) plan to monitor all product handling and maintain the highest quality assurance standards.

Fish will be packaged by registered fish traders, brokers, wholesalers, or other pre-determined fish distribution outlets. Product packaging typically consists of insulation-lined, appropriately labeled cardboard boxes, accommodating various amounts of fish per box, and kept chilled with fresh flaked ice, or gel ice packs, as determined by the purchaser.

Feed Quality and Supply

Feed is purchased only from reputable manufacturers that have rigorous quality control standards. Several such manufacturers exist in the United States and Canada. RCF will also implement protocols to ensure food quality such as proper storage, frequent turn-over, and routine inspection. All feed shipments will be accompanied by a guaranteed chemical analysis certificate, and if purchased from Canada, an export certificate from the Canadian Food Inspection Service and the United States Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) Veterinary import permit. Additionally, HSWRI is involved in many research studies evaluating alternative sources of protein to substitute for the fishmeal portions of fish feeds. The results of these studies will be integrated into the program as commercially available feed formulations are developed.

High quality fish feed is readily available from manufacturers in the United States and Canada. Orders are placed far enough in advance to ensure an uninterrupted supply to support farm operations. HSWRI routinely sources high quality feed from the following manufacturers:

Skretting, Vancouver, Canada
Bio-Oregon, Inc., Washington, USA
Nelson's Silver Cup, Utah, USA

Risk Management

A detailed list of farm specific risks and associated management strategies are described in Appendix IV.

PROJECT BENEFITS

In the 1970s, San Diego was one of the most productive fishing ports in the world. The tuna fleets home-ported in Southern California supported more than 10,000 seafood industry jobs and provided highly prized fish for our nation's dinner table. With the movement of the fleets to western Pacific ports, the jobs and the economic benefits associated with them were lost and now San Diego's seafood industry is a much smaller contributor to the regional economy.

This trend has persisted. Since 2000, the number of licenses issued to California's commercial seafood businesses has declined by 42%. The project proposed by Rose Canyon Fisheries will help rebuild the economic benefits of a seafood industry while providing a product that is both environmentally and economically sustainable.

The proposed farm will produce approximately 5,000 metric tons annually with a landed value six to seven times the current total in San Diego. The enterprise will support approximately 200 regional seafood industry jobs. This will demonstrate how sustainably operated fish farms can help to rebuild the economic benefits to Southern California's coastal communities.

Recent dietary and health studies report that the US population would benefit from doubling its consumption of seafood, and yet we already import 91% of the seafood we consume in this country. In 2010, the National Oceanic and Atmospheric Administration (NOAA) estimated that annual demand will increase by another 2 to 4 million metric tons by 2025. The question is where will we obtain this extra supply?

Only 6.5% of our seafood is caught from domestic fisheries and only 2.3% of our supply comes from domestic aquaculture. Half of the seafood we consume is produced through aquaculture in other countries. Americans will benefit in many ways by scaling up domestic aquaculture production.

This would:

- ensure that the seafood produced was grown under strict US standards and regulations, maximizing food safety;
- lower the carbon footprint of our seafood as domestic product would not have to be transported as far;
- take advantage of existing domestic seafood processing and distribution infrastructure, thereby protecting and expanding jobs in coastal communities;
- provide a new paradigm for the domestic fishing industry by complementing existing business with opportunities to farm fish , and
- offer a sustainable supply of domestic seafood while creating jobs in coastal communities with negligible, if any, impacts on ocean habitats.

Scaling up the proposed farm over time will allow environmental effects to be evaluated, and adverse impacts minimized if not completely mitigated. Federal, state and local agencies responsible for regulating uses of the offshore environment will benefit from the water chemistry and habitat data collected as the farm expands, thereby validating the predictive models developed to support placement of offshore farms. Data collected prior to placement of the farm, during start-up and through all aspects of the farming operation will be available to agency researchers to support their independent analyses of potential impacts to the open ocean environment. The facility will be available for inspections by certifying agencies, and all progress and accomplishments will be disseminated at national and international meetings related to aquaculture and fisheries.

The participation of government agencies, universities, fisheries managers and the scientific community will provide an unprecedented opportunity for study and new technology development through direct experience with an operational, commercial-scale, offshore farm. The transferable knowledge developed from this project will help ensure that the US aquaculture industry is profitable and competitive in the global marketplace. It will create jobs, including new opportunities for commercial fishermen, and it will ensure that the existing infrastructure for fish processing and distribution has a viable future. Finally, it is hoped that this project will serve as a model for the responsible utilization of renewable resources and sustainable development of aquaculture in the US Exclusive Economic Zone, the largest EEZ in the world.

APPENDIX I. QUALITY ASSURANCE PROGRAMS AND RELATED EXPERIENCE

Because of its collective experience, RCF is well aware of the primary concerns related to aquaculture development. Recognizing that successful aquaculture programs require a multidisciplinary approach, RCF has developed supporting collaborations for research and operations in areas related to hatchery and cage production, fish nutrition, fish health, fish physiology, fish reproduction, fish tagging and tracking, genetics, site selection and permitting, environmental monitoring, and systems engineering. In addition, the RCF partnership will utilize an extensive, ever-growing network of outside collaborators to fulfill its problem solving needs.

Hatchery Production

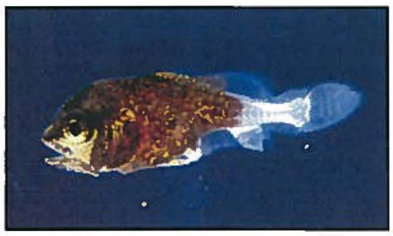


Figure 14. White seabass larvae.

HSWRI is a national leader in the hatchery production of marine finfish and operates a production-scale hatchery in Carlsbad, California capable of rearing millions of fingerling white seabass per year. This is a cooperative program with the California Department of Fish and Wildlife, with all seabass produced being released into the ocean to replenish wild stocks. Each fish has to meet the highest standards of quality in terms of appearance, health and genetic diversity. HSWRI also operates a research-scale hatchery in San Diego for rearing other commercially valuable species – both for replenishment and marine farming. Both these hatchery facilities use state-of-the-art, energy efficient life support systems and have been built and are operated to comply with California's rigorous permit requirements.

Offshore Cage Production

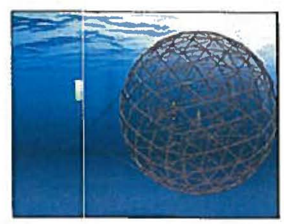


Figure 15. Illustration of an Aquapod

CdM is the global leader of new and innovative sea cage technology, operating in Panama and Mexico as far as 8 miles or 13 km offshore. CdM has the most experience in the operation and deployment of submersible cage systems in the world.

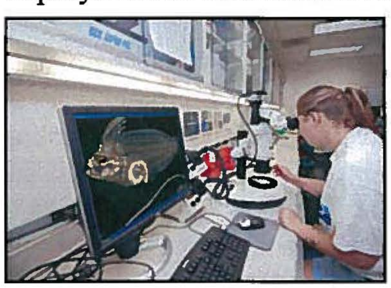


Figure 16. Customized feed development research; tracking gut contents of fish larvae.

Fish Nutrition

Because several of the species being proposed for culture are new for the industry, formulated feeds have not been customized for them. HSWRI has developed its own nutrition program and is also working with nutritionists from the US, Mexico and Japan to develop the needed custom diets, including those with a reduced proportion of fish meal as a raw ingredient.

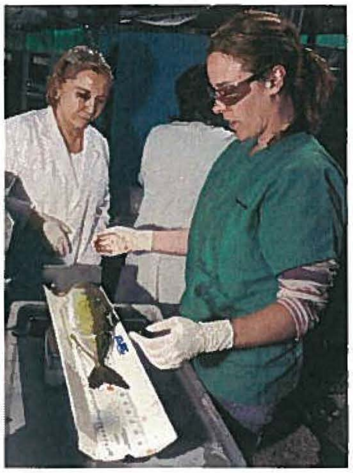


Figure 17. Collecting biological samples as part of initial fish diagnostics.

Fish Health

Scientific understanding of marine pathogens is very limited. While some organisms are relatively easy to identify (e.g. parasites), others (e.g. viruses) are not. RCF scientists have teamed up with a network of local and international fish health professionals to gain access to their expertise and the most sophisticated detection and identification tools available. Additional information on RCF's Fish Health Management Program is found in Appendix III.

Fish Physiology

In order to enhance culture success, it is critical to understand and define the optimal rearing conditions that promote good growth and health in the fish under culture. These conditions are best measured by extensive laboratory trials testing physiological thresholds to variables such as water temperature. HSWRI has established an in-house physiology program and a broadening network of external collaborators.

Figure 18. Larval physiology experimental

Fish Reproduction

HSWRI maintains viable fish breeding populations of several regionally important species, including white seabass, yellowtail jack, and California halibut. Conditions within each breeding population are carefully controlled to provide the optimum environment for each species.

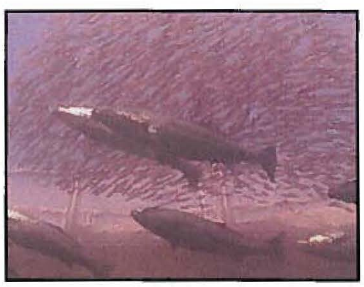


Figure 19. White seabass broodstock.

Fish Marking, Tagging, and Tracking

HSWRI has evaluated a variety of fish tags and tagging techniques, including external, visible implantable, coded wire, and acoustic tags. As part of the white seabass replenishment program, each fish is tagged in the cheek muscle with a coded wire tag, which is unique to each lot of fish released. HSWRI also maintains a post-release assessment program that incorporates sampling of sub-legal sized fish, cooperation between recreational and commercial fishermen, and the use of acoustic tags and tracking techniques to gain a better understanding of released fish and their contribution to the wild population.

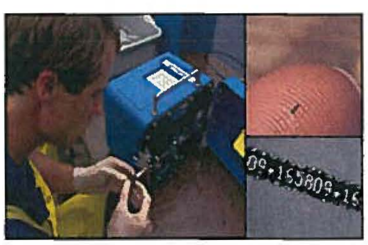


Figure 20. Coded wire tags used for white seabass replenishment.

Genetics

Stock replenishment programs require a substantive understanding of the genetic diversity of the population being supplemented, as well as that of the cultured fish being stocked. Breeding programs for traditional farming will look toward genetic selection to retain and improve positive attributes for culture such as disease resistance and growth enhancement. HSWRI is developing its genetic research program in cooperation with NOAA Fisheries.

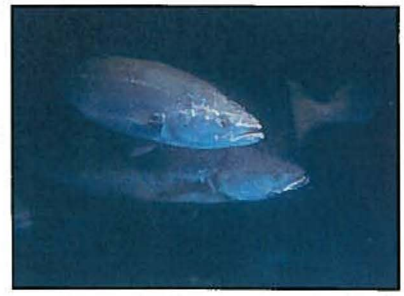


Figure 21. Breeding population of white seabass.

Site Selection and Permitting

Through its extensive experience in operating land-based and coastal facilities, RCF has developed an important core competency in acquiring the permits necessary to conduct aquaculture in the coastal zone, as well as in federal waters. RCF also has the tools and expertise to identify appropriate offshore sites for aquaculture. These include, but are not limited to an Acoustic Doppler Current Profiler (ADCP), which measures ocean currents at intervals from the surface to the sea floor. Data collected from water column currents, sediment and water quality analysis, as well as site and species information are then integrated into modeling programs that simulate water and sediment quality effects of fish farming operations in nearshore and exposed environments.

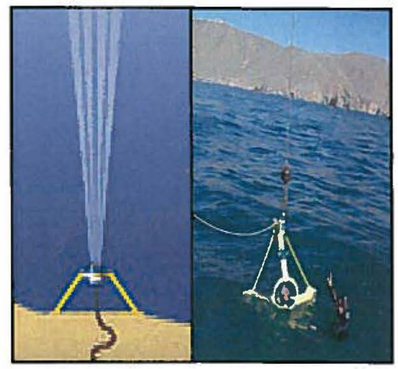


Figure 22. Acoustic Doppler Current Profiler (ADCP).

Environmental Monitoring

RCF has established an extensive environmental monitoring program for its coastal cages in California, Mexico, and Panama. These programs have been developed in consultation with experts from around the country and patterned after the methods used in Washington State and British Columbia to monitor salmon farming operations toward developing best management practices to minimize impacts to the environment. The monitoring program in California has been approved by various coastal agencies in California. HSWRI also monitors effluent from its land-based facilities as a requirement of the Regional Water Quality Control Board.

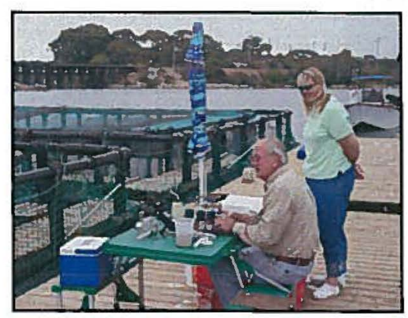


Figure 23. Environmental sampling at net pen operation.

Figure 24. Recirculating flatfish larval and juvenile system.

Systems Engineering

RCF has developed an in-house capability for designing efficient and functional flow-through and recirculating life support systems for fish. These systems are critical for maintaining brood fish and rearing large numbers of sensitive larval and juvenile stages of marine finfish that can ultimately be stocked into cages.

APPENDIX II. SITE MAP AND MOORING CONFIGURATION FOR ROSE CANYON FISHERIES SUSTAINABLE AQUACULTURE DEMONSTRATION PROJECT

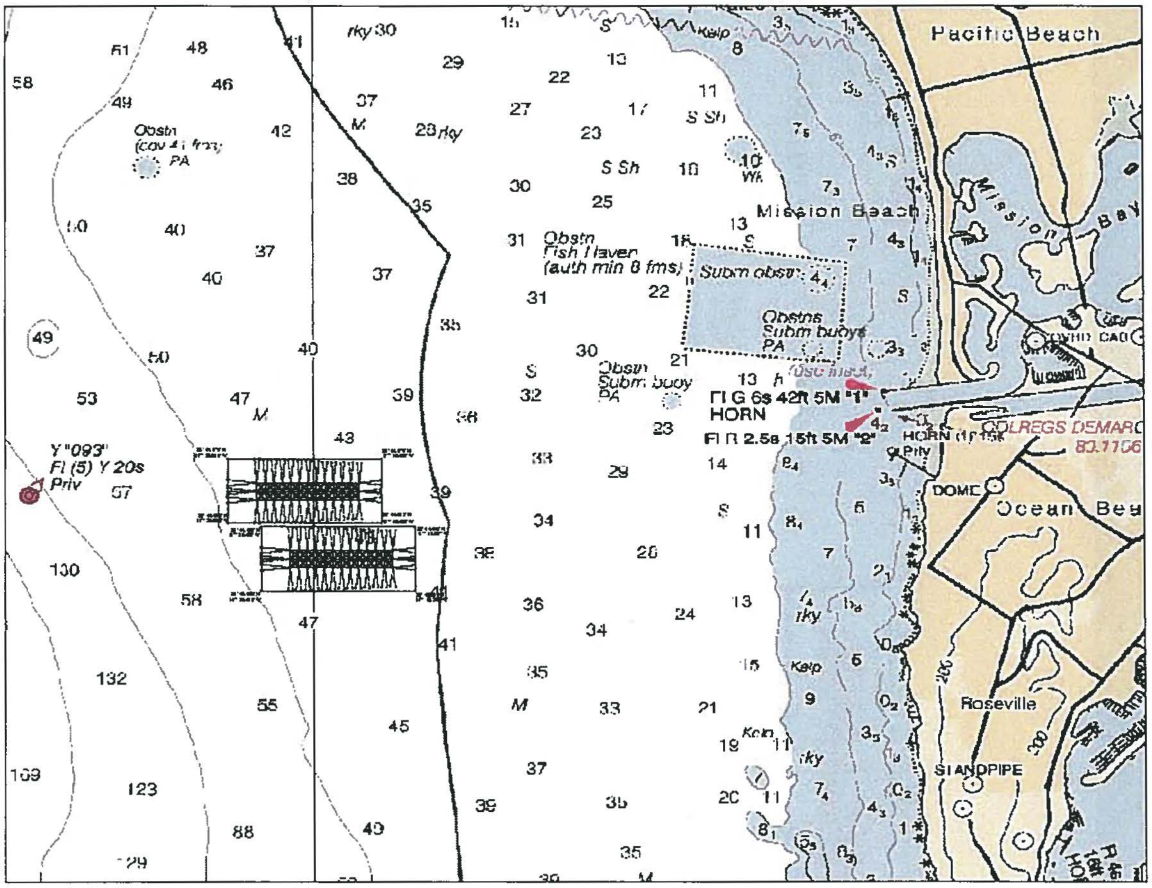


Figure 25. Project location: site detail with cage grid overlay

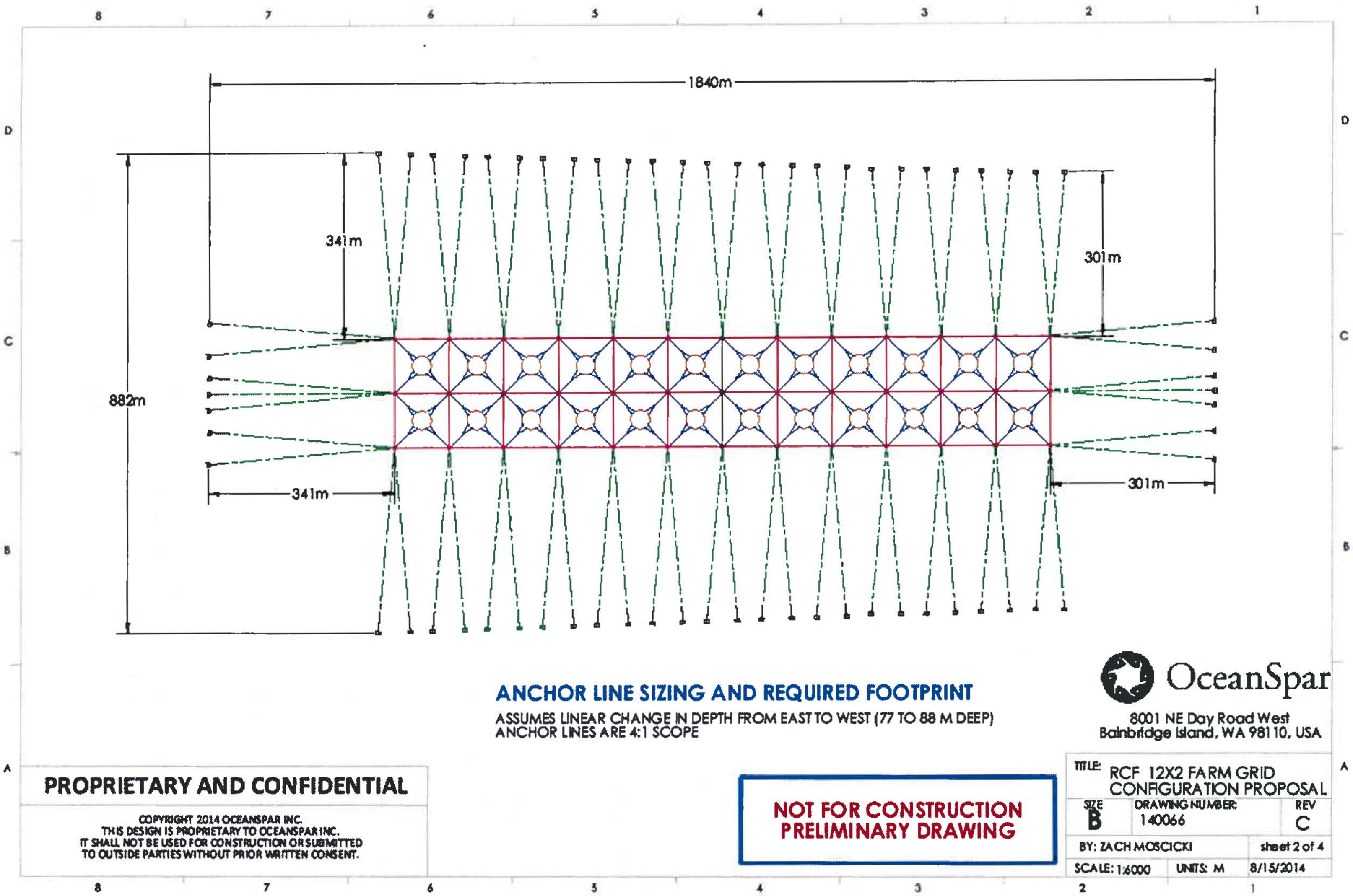
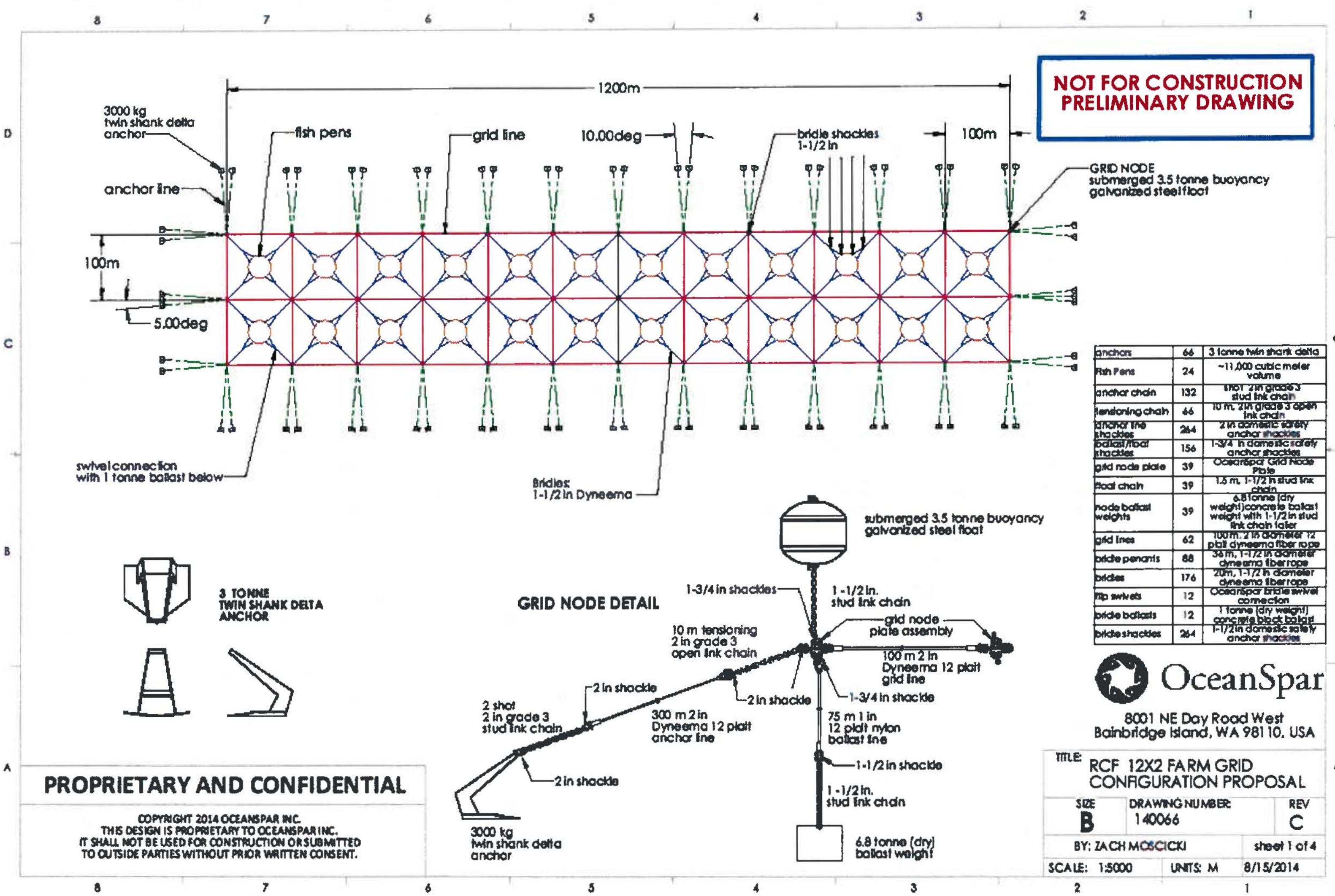


Figure 26. Mooring diagram of one cage grid.



anchors	66	3 tonne twin shank delta
Fish Pens	24	~11,000 cubic meter volume
anchor chain	132	shot 2 in grade 3 stud link chain
tensioning chain	66	10 m, 2 in grade 3 open link chain
anchor line shackles	264	2 in domestic safety anchor shackles
ballast/float shackles	156	1-3/4 in domestic safety anchor shackles
grid node plate	39	OceanSpar Grid Node Plate
float chain	39	1.5 m, 1-1/2 in stud link chain
node ballast weights	39	6.8 tonne (dry weight) concrete ballast weight with 1-1/2 in stud link chain tailer
grid lines	62	100 m, 2 in diameter 12 plait dyneema fiber rope
bridle penants	88	36 m, 1-1/2 in diameter dyneema fiber rope
bridles	176	20m, 1-1/2 in diameter dyneema fiber rope
flip swivels	12	OceanSpar bridle swivel connection
bridle ballasts	12	1 tonne (dry weight) concrete block ballast
bridle shackles	264	1-1/2 in domestic safety anchor shackles

Figure 27. Plan and elevation view drawings of cage grid and mooring system components

APPENDIX III. FISH HEALTH MANAGEMENT

Disease Prevention

RCF's approach to aquaculture health management begins with disease prevention. Disease prevention is only possible when the culture requirements of the animal are well understood and accommodated to every extent possible, or when best management practices are employed for new species. Examples of culture requirements and best management practices are discussed below. It is important to recognize that factors affecting fish health status are complex. Fish health status cannot be determined solely by the presence or absence of infectious agents (i.e. pathogens). More often than not, infectious diseases that lead to death of the host are opportunistic and secondary to some other stressor (e.g. poor water quality, nutrition, husbandry, immunity) that is the primary cause of mortality. The application of antibiotics and chemicals to control disease is governed by the US Food and Drug Administration's (FDA's) Center for Veterinary Medicine (CVM), and is limited to 1) approved drugs, 2) special category and low regulatory priority compounds, 3) veterinarian prescription by "extra label use", and 4) Investigational New Animal Drug (INAD) research programs.

Stock origin and biosecurity

All fish species proposed to be grown are native to or established in California. Biosecurity refers to measures taken to ensure that the fish in culture are secure from infectious agents. Potential vectors for disease are identified and mitigated to every extent possible. When new fish are brought into the hatchery or cages, they are inspected by a certified health professional, quarantined, and treated for any diseases as necessary. Water is sterilized using ultraviolet light, and ozone in recirculating systems, and the volume of new water added is relatively small. Employing these procedures minimizes the risk of introducing diseases from other culture facilities or wild fish. Similar safeguards are employed with regard to feeds, where only fresh, high quality fish food is used. Good hygiene practices are employed with regard to culture systems, equipment and personnel. All nets, siphon hoses, feed containers, and any other equipment used for operations are cleaned and disinfected after use. Each rearing system has its own footbath for personnel moving between systems for cleaning and feeding. Mortalities are removed and disposed of immediately, so they do not provide an additional vector for disease.

Environmental conditions

Environmental requirements vary among species, but can often be inferred based on the lifestyle of the species in the wild. Water quality is extremely important for aquatic organisms; therefore, the quality of the water is maintained at high standards to avoid stress and disease. Many common diseases occur because of poor water quality. Good water quality is characterized by high dissolved oxygen, and low levels of waste (ammonia, nitrite, and suspended solids). These parameters are measured daily and compensated for by properly designed systems and sound husbandry practices. Adequate water flow, particulate and biological filtration, supplemental aeration, good feeding practices, and routine cleaning are the key elements to maintaining excellent water quality. Water temperature is also very important. Species selected for culture must be tolerant of the full range of temperatures experienced at an offshore farm site, or the temperature must be controlled when possible such as at the hatchery facility. Other environmental variables such as lighting (quality, intensity, and photoperiod), current velocity, and vibration must be optimized in order to reduce stress.

General husbandry

Good husbandry practices are a key element to health management. Husbandry is a general term that refers to how the animals are cared for and therefore encompasses many of the topics being discussed. Fish densities are maintained at a level that is compatible with a given species' tolerance for crowding and the engineered capacity of the system. Physical or visual exposure to potential predators can be a major source of stress to cultured fish. This exposure is avoided by employing predator nets outside cage systems, and grading fish to reduce cannibalism in tank systems. Whenever fish are handled (e.g. for grading), techniques are used that minimize stress and physical trauma to the fish's protective mucous layer. Examples of these techniques include keeping the fish suspended in water whenever possible, using knotless mesh nets, wearing gloves in case of contact, and commercially available mucous-restoring compounds. Culture systems are sterilized between crops. Cage nets are cleaned and cages may be left to fallow for several weeks prior to restocking.

Feeding and nutrition

Good nutrition is the foundation for a healthy fish and fast growth. Fish are fed only fresh, high quality feeds. Hand feeding allows daily assessment of the activity level, health status, and satiation level of the fish. Multiple feedings throughout the day are facilitated by automatic feed delivery systems. Feeding schedules are adjusted to match the activity patterns of the fish.

Prophylactic measures

At the present time little is done in the way of medical prophylaxis; therefore strict biosecurity protocols are followed as prophylactic measures against pathogen introduction. This is due largely to the fact that the marine finfish culture industry is new and species-specific prophylactic treatments (e.g. vaccines) have not been developed. For example, newly spawned eggs are immersed in a dilute formalin bath as a prophylactic treatment. The formalin rids the surface of bacteria and fungi and helps prevent potential pathogens being transferred from the adults to the larvae at hatching.

APPENDIX IV. RISKS AND RISK MANAGEMENT

Extreme Weather

Working offshore in potentially hostile ocean conditions represents a possible risk to any ocean farm. Damage from storms can lead to equipment damage, physical injury and loss of stock. These risks can be mitigated if the appropriate equipment, engineering and experience are matched to the site-specific ocean conditions.

The project will use sea cages that have been proven effective in hostile, offshore environments. This includes withstanding hurricanes and typhoons, as well as routine currents of up to 4 knots and seas in excess of 8 m. While the equipment is proven effective in these conditions, actual observed conditions at the proposed site fall well below these criteria. Project personnel have direct experience working with these types of systems in harsh environments. The equipment is off-the-shelf technology, and available for all phases of production. Critical to the success of these systems are their associated mooring and anchoring configurations. Project personnel, equipment manufacturers and licensed marine contractors are working together to ensure that the appropriate mooring system is selected and installed properly according to site-specific characteristics. All installations will be inspected on a regular basis and after storm events.

Pollution

Pollution in the form of land-based discharges, storm water run-off, and harmful algal blooms (HABs) represents a potential risk to livestock in ocean farms. These risks can be mitigated in a variety of ways that include 1) siting the farm outside the range of discharge plumes and HABs, 2) working with species that are more tolerant to HABs, 3) using submerged cages to keep the fish below the affected surface layer, and 4) having a quick response plan that allows cages to be moved outside the polluted zone.

The project plan is to site the cages to avoid pollution events in pristine waters that are outside the coastal zone. The coastline of southern California is well studied, so that the characteristics of pollution plumes are well documented and have been modeled relative to seasonal currents and storm effects.

Predation

Fish losses or system damage from predators and vandals is a potential risk to ocean farms. Potential predators include sharks, marine mammals, birds and people. The risk of predation can be mitigated by 1) removing mortalities routinely from the cages, 2) using anti-predator devices, and 3) having a comprehensive and responsive security program. The project will use a combination of each of these measures as detailed below.

1) Sharks can be avoided by proper management and implementation of sound mitigation measures. At all of RCF's cage systems, best management practices will be implemented into all daily routines to ensure that predator interactions are minimized and optimal husbandry requirements are met.

2) Three types of submersible cages could potentially be used for the project. Double Rim (DR) SeaStation and traditional SeaStation fish cages are designed for large-scale submerged or surface operations in medium-to-high energy open ocean sites (Figure 8). SeaStation's patented, central spar design provides excellent sea-keeping abilities in open ocean conditions and through major storm events. Cages are constructed with a galvanized steel framework, surrounded with an option of different netting materials, depending on the operator's preference. In other parts of the world these cages have been installed and are currently being operated at commercial production levels. RCF proposes using 11,000 m^3 cages and increasing the number of cages being used incrementally to a maximum of 24 cages per mooring grid. The Aquapod submersible fish cage is a unique containment system for marine aquaculture, suited for rough open ocean conditions and a diversity of species. The Aquapod is constructed of individual triangle net panels fastened together in a spheroid shape. Most Aquapod net panels are made of reinforced high density polyethylene with 80% recycled content and covered with coated galvanized steel wire mesh netting. Individual net panels or groups of panels are modified to accommodate other functions, such as access, feeding, fish transfer, grading, and harvesting. The Aquapod functions as a secure containment system for finfish while submerged or partially surfaced.

3) For both gravity cages and DR SeaStation cages, Kikko Net mesh material can be used and is a Tetron plastic wire that can be molded into a variety of mesh sizes. The strong material acts as its own predator exclusion mesh. The nets are environmentally friendly as no harmful materials are included in the raw material, and nonconductive to electricity. Additionally, because Kikko Net is non-fibrous, fouling does not grow into the material itself making it easier to clean than standard woven fish netting.

The California sea lion is commonly found in colonies along the southern California coast and is known to haul out on navigation buoys and other types of floating surfaces. Anti-predator nets will help deter sea lions from the sea cages beneath the surface. The design of the DR cage already incorporates a cone shaped net when the cage operates at the surface that acts both as sea lion and bird predator deterrent. In the case of gravity cages, a simple net "fence", with a mesh size of 8 cm stretch and 2 m height will be installed around the cage collar at the surface so that sea lions will not be allowed onto the cage structure and to prevent them from being able to jump inside. This method is simple and has been proven effective on marine cage farms located in Mexico and in British Columbia.

4) To avoid predation by birds, net material is typically stretched over the top of the cage and attached to the handrails of the cage collar. DR SeaStations already incorporate a bird net in the cone shaped net when the system operates at the surface. For the gravity

cages, cover nets, or bird nets installed on cages as part of this project will be 2.5 to 5 cm square mesh and be stretched taut over the cage surface, be of high visibility cover, as well as be marked with reflectors to reveal the presence of the nets as an additional measure to prevent entanglements.

5) The project will have security staff present 24 hours a day on a moored vessel. Constant security will decrease the risk of any vandalism or theft.

Rose Canyon
FISHERIES

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