Ocean Ranch

**Intro**

Ocean Ranch is a regenerative aquaculture farm producing fresh ecological seafood and vegetables for the Fly Ranch community with no negative impact on the Earth. Designed to scale, the greenhouse can expand to support a significant portion of the caloric and nutritional needs of the Fly Ranch community - organic, vegetarian-fed, no antibiotics, no toxins, ecologically clean food. Seafood and vegetable harvest is made on-demand year round, only harvesting what is needed for the day’s meals; always fresh, never frozen, clean food. Ocean Ranch at Fly Ranch will prove a new model for sustainable regenerative aquaculture with no impact on the oceans or local environment.

**Technology**

Ocean Ranch is built on the most innovative technologies in regenerative aquaculture - recirculating aquaculture, biofloc, aquaponics & ecological water treatment. This allows the farm to operate efficiently & environmentally in a closed ecological system - reuse of water, low power consumption, minimal inputs, & no negative outputs.

Aquaponics is the combination of hydroponics and recirculating aquaculture in a symbiotic relationship. The aquatic life feeds the plants, and the plants clean the water while also providing feed for the aquatic life. This ecological system allows for the continued cycle of life while producing significant crops for human consumption with drastically reduced need for externally sourced inputs relative to traditional farming methods.

Recirculating Aquaculture or RAS is a land based closed system using biological filters to clean and reuse the production water. Biofloc is an aquaculture management process that encourages the growth of 180+ naturally occurring microorganisms. These organisms flocculate on organic matter like effluent, excess feed, & decaying plant matter. The fish then eat the biofloc, reducing feed input requirements, increasing farm efficiency & improving the aquatic life immune system.

Hydroponics is the growth of plants in a soilless medium, delivering nutrients through the irrigation water. Rather than dosing the irrigation system with fertilizers, aquaponics utilizes the aquatic life effluent as fertilizer - the ammonia is processed by nitrifying bacteria into nitrates. The use of living water that has been nitrified through this natural process has been proven to increase crop yields and overall plant health with little need for trace mineral balancing. Irrigation water can be delivered to plants in a variety of methods including deep water culture (DWC) rafts, nutrient film technique (NFT) and media beds.

A wide variety of high yield crops can be cultivated within the aquaponics farm including: tilapia, catfish, giant freshwater prawn, red claw crayfish, a variety of leafy greens, lettuce, kale, collard greens, chard, bok choy, mustard, watercress, duckweed, variety of peppers, tomatoes, cucumbers, variety of beans & lentils, eggplant, okra, corn, mint, basil, and a variety of herbs. Non-food industrial crops can include structural bamboo, fibers, oilseed & sugarcane. By “decoupling” the system we can accommodate crops with sensitivity to irrigation water pH or temperature, like citrus, fruits & nuts.

**Activity Support**

The farm is staffed by 4 full-time trained aquaculturists and horticulturalists. Additional part-time harvest personnel will be needed for larger harvests.

An oasis of waterfall sounds, sunlight and visual greens of thriving plants, the warm refuge of the greenhouse will act as a gathering & recreation space for groups to collect inside the food forest. The polycarbonate walls and roof capture, defract and diffuse light in both day and night. RGB LED flood lights will create the vibrant and reminiscent nighttime atmosphere that we have all come to call Home.

Using the same principles set forth in this design, as an ecological wastewater treatment plant, Ocean Ranch can transform blackwater waste into agriculture or drinking water within a 4 day process.

**System Inputs**

Seed Stock

* Fish and crustacean broodstock with on-site hatchery program to produce future supply (requires Commercial Possession of Live Wildlife Permit issued by Nevada Department of Wildlife)
  + Mozambique tilapia (Oreochromis mossambicus) or Nile tilapia (Oreochromis niloticus)
  + Giant River Prawn (Macrobrachium rosenbergii)
  + Red Claw Crayfish (Cherax quadricarinatus)
  + Catfish (Ictalurus punctatus)
* Plant seeds with seed harvesting & cloning for future supply
* Waste & Water Treatment
  + Snails & micro-organisms sourced from local ecosystem
  + Black soldier fly (BSF) larvae
  + Select plant species to remove heavy metals & contaminants

**Recurring Inputs**

* Total power consumed is 35kWh and sourced from renewable production at Fly Ranch.
* Water requirements include 300m3 for initial fill + up to 10% per day for evaporation.
* Fish Feed: Feed Conversion Ratio of 1kg (FCR) or 1.5kg of feed for every 1kg of fish produced
  + Estimated to require 6,150kg of feed annually
  + Feed can be produced at Fly Ranch using BSF larvae & carbohydrate waste
* Access to the geothermal heat available at Fly Ranch for greenhouse and pond climate control.
* Fish broodstock
* Vegetable seedstock and seedlings
* Minerals: chelated iron, sodium bicarbonate, trace salts & minerals
* Laboratory & farm expendables

**System Outputs**

Beneficial System Outputs

* Seafood @ 4,100kg/year or 79kg/week
  + Tilapia 1,500kg/year or 29kg/week
  + Catfish 1,000kg/year or 19kg/week
  + Prawn 800kg/year or 15kg/week
  + Crayfish 800kg/year or 15kg/day
* Vegetables @ 5,400kg/year or 103kg/week, can be scaled up to a 10:1 ratio of plant to fish output.
* Plant & fish trimmings and pond sludge waste to be composted and used as fertilizer
* Pond sludge can be used in a biogas digester to produce hydrocarbon fuel

Waste Produced

* Minimal packaging waste from inputs sourced outside of Fly Ranch.
* Minimal black water waste from sanitation and cleaning routines.

**Primary Materials in Design**

Water and sand are the two components of this project. Found as opposites in the world, the forms they take in their natural state can be remarkably similar. Ocean Ranch draws upon these similarities as inspiration. The vertical lines are the eel grass reaching towards the sun for photosynthesis while also creating a habitat for the creatures below. The greenhouse is home to both the flora and fauna of Fly Ranch, capturing the sun’s rays for solar gain creating warmth, while encouraging natural photosynthesis of the interior constructed wetland ecosystem.

The design is scalable to meet production goals, as depicted here, the structure is 16m by 18m for 288m2 of interior floor space accommodating 500m3 of aquaponic production across 20 tanks and 300m2 of vertical hydroponic vegetable production.

Greenhouse Structure

* Sustainably Sourced Timber
* Recycled Polycarbonate
* Eco Concrete
* Steel

Aquaponics (Recycled, Reclaimed, Reused, Sustainable Materials Where Possible)

* Aquaculture Equipment - 3 modules for biosecurity
  + HDPE liner
  + 5hp water pump
  + VFD
  + Pressure transducer
  + Fractionator
  + Barrel settling tank
  + Barrel biofilter with bio-media
  + Solar water heater and geothermal heat capture from local geysers
  + Recycled IBC water reservoirs
  + Venturi Injectors
  + Blower compressor
* Hydroponics
  + DWC raft equipment
    - Pond liner or poly film
    - Polystyrene raft boards
  + NFT equipment
    - Solid rain gutters
  + Media bed/bucket equipment
    - 3-5gal reclaimed buckets
    - IBC totes or liner
  + Net pots
  + Coco husk & expanded clay root substrate
* Wood for support framing
* PVC Plumbing: pipes, fittings, valves
* PPE: sanitary & disinfectant supplies
* Harvest supplies: snips, ties, rubberbands, crates & baskets
* Variety of fasteners, glues & caulk
* Various gauge netting, mesh, & fibers

**Cost Estimate**

Fy Ranch’s Ocean Ranch aquaponics farm as depicted here is estimated at $400,000 USD. Variables driving the final costs will include engineering and permitting, resources available to the build crew, and desired production scale to support the Fly Ranch community.

A scale prototype using lower cost, shorter service life & less sustainable materials is estimated at $90,000 USD.

**On-site Prototype**

To prototype the design and technology behind Ocean Ranch, we will construct a single production module pilot farm with service life of approx 5 years. Our objective in the prototype is to confirm polyculture stability, flora and fauna tolerances, temperature control, evaporation rates, production output and to develop standard operating procedures.

The prototype will consist of three inflated poly greenhouses, one greenhouse for aquaculture, and two greenhouses dedicated to hydroponics. DWC, NFT and media bed techniques will be used to maximize photosynthesis, and floor space.

**Environmental Impact**

Traditional agriculture generates 12% of total greenhouse gas (GHG) emissions with the livestock sector responsible for 40% of that total. Regenerative aquaculture allows Fly Ranch to create a sustainable and low GHG society, merging sustainable practices in both terrestrial agriculture and aquaculture, for a low input and high yield operation.

Our seafood and veggies are produced organically with near zero-carbon footprint. The only power consumed on the farm is to run the water pumps and comes from renewable sources generated by infrastructure projects at Fly Ranch including geothermal, solar, and wind. The heat generated for the greenhouse comes from direct solar gain, solar water heating, and local geothermal heat transfer.

All exchange water from the farm is processed and recirculated as clean water. There is no downstream effect on the local environment or community waste system. After the initial fill, the only water added to the system is to compensate for evaporation, production water can be used for many years without the need to flush the system.

The fish trimmings, plant cuttings and waste sludge from the farm is dewatered and composted with Black Soldier Fly larvae, producing a nitrogen rich fertilizer for use on agricultural activities at Fly Ranch. The BSL larvae harvested from the compost and carbohydrate waste generated at Fly Ranch can be further processed into fish feed, closing the community’s waste loop and significantly reducing the need for external inputs into the system.

The architectural and equipment design selects the lowest impact and sustainably sourced materials available while maximizing service life.