

Board of Trustees Meeting

Friday, October 30, 2026

via Zoom Conference Call: [Join Zoom Meeting](#)

10:00 a.m. to noon Pacific Time; 1:00 p.m. to 3:00 p.m. Eastern Time

Agenda

- | | |
|--|--------------|
| 1. Meeting called to order/Quorum noted | Mr. Stewart |
| 2. Welcome and introductions | Mr. Stewart |
| 3. Motion to wave reading of the Minutes of the July Board Meeting | Mr. Stewart |
| 4. Nominating Committee | Mr. Stewart |
| - Approve Board Slate (No new nominees) | |
| - Approval of Corporate Officers | |
| - Approval of POF Board (Nomination of David Hong) | |
| - Approval of HFOF Board | |
| 5. Audit Report Delayed | Mr. Weiner |
| 6. Finance Committee | Mr. Gardner |
| 7. Development Committee | Ms. Thompson |
| 8. Science Committee | Dr. Dold |
| - Science Presentation, Kevin Stuart, Aquaculture Lead MBL | |
| 9. Corporate and Government Relations Committee | Mr. King |
| 10. Press Packet | Mr. Kent |
| 11. Past Business | Mr. Stewart |
| 12. Future Business | Mr. Stewart |
| - Next Meeting: Friday, January 29, 2027 | |
| 13. Adjournment | |

HUBBS–SEAWORLD RESEARCH INSTITUTE

Board of Trustees Meeting — Minutes

July 24, 2026

1. In Memoriam — Bob "Dart" Fletcher

The board paused to honor Bob Fletcher, a 33-year board member and longtime fisheries leader who recently passed away. Don, Louie, and Bill each shared remembrances. A family celebration of life is being planned for October/November; Louie will keep the board posted.

2. Approval of Minutes

Motion by Bill Shedd to waive reading of the July minutes: seconded by Robert Weiner, no discussion, passed unanimously.

3. Nominating Committee

No changes to the board slate. Ian and Don have had preliminary talks on future board composition and fundraising focus areas; nothing formal brought forward this meeting.

4. Science Committee

- Nearly \$2M in grants submitted (5 proposals), mostly aquaculture; a hoped-for Florida state appropriation was vetoed by the Governor, though a separate federal appropriation for Indian River Lagoon aquaculture infrastructure is still being finalized.
- Quarter stats: 4 publications, 5 panel talks, 6 invited seminars, 39 active externally-funded projects (24 students), 10 outreach events reaching 1,500+ people, 10 acres of seagrass replanted, 10 marine mammal strandings responded to (incl. 2 dolphin disentanglements).
- Sea Bass in the Classroom remains high-impact but future funding is undetermined.
- CI Farm award: Hubbs is the West Coast partner (CA/OR/WA/AK) in NOAA Fisheries' new 5-institution Cooperative Institute, a long-term science-support partnership (not a standard grant), with a required K–14 education component. Term is 5 years (renewable to 10); \$300M ceiling over 5 years, but current annual appropriation is \$5M. Hubbs and partners requested \$9M of ~\$13.5M available; Hubbs' initial share is ~\$1.7M (split 5 ways), with ~60% of next year's tranche expected. Additional "soft mark" funds (e.g., \$1M already contributed by the East Coast Shellfish Growers Association) can flow in from outside the base appropriation.
- Three focus areas: infrastructure/education (test beds, workforce training), science advice (permitting, market/economic analysis, plus a planned AI decision-support tool), and production technology (finfish/shellfish/seaweed/IMTA, incl. small-scale "AquaFort" demo units).
- Objective is to expand NOAA's in-house science capacity and support permitting decisions, not a stated production-volume target; industry and research growth are expected to move together.

5. Corporate & Government Relations

- Comments submitted on the CA Ocean Protection Council's Aquaculture Action Plan, noting marine finfish aquaculture was omitted from the state's plan.
- NOAA Office of Protected Resources letter on marine mammal strandings shared with the Florida team (in board packet).

- MARA Act is early-stage, currently in House Natural Resources and Education & Workforce Committees.
- Proposed CCA California OREHP legislation would expand license fees statewide (into Northern CA), raising additional program revenue; CA Fish and Wildlife supports it.
- Don raised concerns about CA's regulatory climate for finfish aquaculture (citing opposition from groups like Monterey Bay Aquarium's Seafood Watch); the Institute is drafting a California aquaculture vision white paper as a science-based counterpoint.

6. Finance Report — FY July 2025–June 2026

- Budgeted for a loss; finished with a ~\$300K surplus (a ~\$900K swing), despite a ~66% drop in contributions (loss of SeaWorld and Chevron gifts).
- Cash grew from ~\$366K to ~\$732K; total assets grew from ~\$7.6M to ~\$8.2M; equity up ~\$300K, matching net income.
- Total expenses down ~11.8% YoY (~16% under budget); salary/fringe down ~\$599K (~14%) from layoffs and voluntary leadership pay cuts; outside services up 43% (~\$125K) for HR/legal/compliance consulting to manage restructuring.
- Secured a \$1M line of credit (collateralized by Mission Bay property) to bridge grant reimbursement timing; current liabilities rose to ~\$952K accordingly. Indirect cost rate cut from ~44% to ~25%.
- Outlook: CI Farm cash flow timing (expected ~October) still uncertain, budgeting conservatively; an anonymous \$3M gift is expected next week (check, full amount) to support offshore permitting and a new reserve fund — Hubbs will retain ownership of the resulting permits.
- Board thanked Don and Lenell for the turnaround, and Bill/Paul for a \$150K contribution that helped secure the credit line.

7. Development & Branding

- No dedicated development staff since January; scientist-led grant writing has filled the gap. Laura volunteered time to support grant writing.
- Branding/messaging statements on aquaculture will be circulated to the board for comment; recommendation to retain the "SeaWorld" name given recent fundraising success under it.
- USD marketing students are supporting community outreach ahead of the offshore farm's Environmental Impact Statement (EIS) release.
- Near-term priorities: update website to foreground aquaculture; finalize messaging; support the offshore farm as a signature program; complete the CA aquaculture vision white paper; recruit board members as aquaculture ambassadors; develop unifying public messaging ("Got Milk"-style) on aquaculture's role in sustainable food supply.

8. Motion: Aquaculture Budget Priority

Bill moved (seconded by Paul) that the Institute "shall spend 80% or more of its approved budget on aquaculture, either directly or indirectly... This limitation shall not apply to any program fully funded by direct grants and/or other donations."

Discussion: Board members generally supported prioritizing aquaculture but were split on locking in a fixed target given financial uncertainty; suggestions ranged from a lower percentage to a 60–80% range. Don and Lenell noted current unfunded science salary is already ~95–100% aquaculture-aligned in practice.

Outcome: Bill amended the motion to a 60–80% range, then withdrew it rather than force a vote, asking staff to bring a detailed budget breakdown by program area to the Finance

Committee. No vote was taken. This will be the primary discussion topic at the next board meeting.

9. Next Meeting & Adjournment

Next board meeting: Friday, October 30 (annual audit review plus the aquaculture budget discussion above). With no further business, the Chair adjourned the meeting.

Q1 Nominating Committee Highlights



- No new trustee nominations
- John Forster has retired from POF Board
 - Propose David Hong from Soboba Tribe to fill seat
- Adoption of Slate of trustees, directors and officers



SOBOBA ECONOMIC DEVELOPMENT CORPORATION



Soboba Economic Development Corporation Welcomes David S. Hong to the Board of Directors

David Hong serves as a Director for Soboba Economic Development Corporation, bringing a strong background in tribal governance, legal compliance, and strategic contract negotiation. He currently works as a Paralegal supporting both tribal government and gaming enterprise operations, where he assists in reviewing, drafting, and negotiating multimillion-dollar agreements, ensuring regulatory compliance, and assisting in advising executive leadership and Tribal Council on legal and policy matters.

David has extensive experience in federal Indian law, contracts, probate, dependency, and property law. His work includes assisting with drafting tribal laws, governmental resolutions, and internal policies and procedures that strengthen institutional governance and operational accountability. He also serves as a key liaison for legal correspondence and intergovernmental matters, supporting collaborative relationships across agencies and stakeholders.

Academically, David is pursuing his Juris Doctor at the University of La Verne College of Law, with an expected graduation in December 2028. He earned his Bachelor of Science in Public Administration, graduating Summa Cum Laude with a 4.0 GPA, and previously completed his Associate of Arts in Paralegal Studies as Valedictorian.

David is committed to long-term service to the Soboba community and, upon completion of law school, intends to continue supporting and assisting the Tribe in advancing its legal, governmental, and economic development initiatives. Fluent in English and Korean, he brings dedication, integrity, and a forward-looking perspective to his role on the Board.

DAVID S. HONG

DAVIDSHONG88@GMAIL.COM • (909) 602-2400
12657 REED AVENUE • GRAND TERRACE, CA 92313

SKILLS & ABILITIES

- Experience in directing economic development generating revenue and jobs through various commercial projects.
- Experience in developing tribal governmental policies and procedures and ensuring adherence to said policies and procedures.
- Experience with negotiations in multimillion dollar agreements and contracts, both for tribal governments and gaming enterprises.
- Experience in many areas of law, including federal Indian law, probate, dependency, contracts, and property law.
- Bilingual – English and Korean

WORK EXPERIENCE

Director – Board Member

2/14/26 – Present

- Assist with new business attraction initiatives.
- Coordinate new commercial project development.
- Manage all aspects of corporation, including subsidiary businesses.

**Soboba Economic
Dev. Corp.**
San Jacinto, CA

Paralegal

6/25/18 – Present

- Assist with both tribal government and gaming enterprise contracts including: reviewing, revising, drafting, negotiating and ensuring compliance.
- Complete legal research regarding various tribal government functions and present findings to supervising attorney, C-level management, and Tribal Council.
- Assist in drafting of tribal laws, policies and procedures, and tribal governmental resolutions.
- Provide correspondence as main point of contact for the tribal legal department, including intergovernmental correspondence.

**Soboba Band of
Luiseño Indians**
San Jacinto, CA

EDUCATION

<i>Juris Doctor - Student</i>	1/2025 – Present
▪ Expected graduation: December 2029. ▪ Member of Law Review.	Univ. of La Verne School of Law Ontario, CA
<i>Bachelors of Science in Public Administration</i>	6/2022 – 12/2023
▪ Graduated with a 4.0 institutional GPA. ▪ Summa Cum Laude and on the Dean's List.	Univ. of La Verne La Verne, CA
<i>Associates of Arts in Paralegal Studies</i>	3/2017 – 5/2018
▪ Graduated Valedictorian of the '18 class. ▪ Summa Cum Laude and on the Dean's List.	Fremont College Cerritos, CA

REFERENCES

Multiple professional references available upon request.

Proposed HSWRI Slate

Oct 2026



	HSWRI Board of Trustees Board Slate (Oct. 2026)	Trustee Since	Executive	Nominating	Audit	Finance	Science	Government Relations	Development
#	Tyler Carter	Jan-25		X	X	X			
2	Chris Dold	Sep-16	X	X			Chair		
3	Paul Fruchbom	Apr-20		-		X	X		-
4	David Gardner	Sep-93	X			Chair	-		
5	Reese Jarret	Apr-25					-		
6	Michael King	Jun-22						Chair	
7	Laura MacKinnon	Jun-22		X					X
8	Michelle Murrell	Oct-26						X	
9	Linda Pazin	Oct-25							
10	Justin Quis Quis	Jul-25							
11	Bill Shedd - Past Chair	Apr-94	X	X	X		X		X
12	Cody Shedd (TBE)	Oct-25							
13	Ian Stewart - Chair	Jan-21	Chair	Chair		X	X	X	X
14	Amber Ter Vrgut	Jan-26						X	
15	Laurilee Thompson	Sep-16	X	X			X	X	Chair
16	Robert Weiner	Jan-21		-	Chair				-
17	Louis Zimm	Jul-13					X		
	Trustees Emeriti								
	Dede Alpert								
	Art DeFever (deceased)								
	Char DeMotte								
	George Gildred (deceased)								
	Dr. Clark Hubbs, Science Committee Chair Emeriti (deceased)								
	Cpt. Wally Schirra, USN, Retired (deceased)								
	Milton Shedd, Chairman Emeriti (deceased)								
	Officers								
	Donald B. Kent, CEO/President		Ex Officio	Ex Officio		Ex Officio	Ex Officio	Ex Officio	Ex Officio
	Lenell Carter, CFO/Secretary				Ex Officio	Ex Officio			
	HFOF Board		POF Board						
	Chris Dold, Chair		Don Kent, Chair						
	Jeff Eble		Andrew Fichthorn						
	Don Kent		David Hong (Proposed)						
	Wendy Noke-Durden								
	Laurilee Thompson								

HUBBS-SEAWORLD RESEARCH INSTITUTE

Q1 FY2026-27 Finance Committee Report

First Quarter: July 1, 2026 – September 30, 2026

Prepared for the Board of Trustees | October 2026

A Strong Start to FY27

Financial Highlights — Q1 FY2026-27 (Jul-Sep 2026)



NET INCOME, Q1

\$2.95M

vs. (\$2.46M) loss in Q1 FY26;
includes \$3.0M one-time gift

CASH & BANK, 9/30/26

\$3.10M

vs. \$32K a year ago; much is
restricted to funded projects

TOTAL EXPENSE

-24.5%

\$1.33M vs. \$1.76M in Q1
FY26;
salaries & fringe down 28%

PROJECT INVOICES, Q1

\$1.15M

\$678K mailed (cash) +
\$470K in-house (prepaid
draw-down)

What Happened This Quarter

- Net income of \$2,954,909 reflects \$3.02M of contributed support recorded in the Fundraising class, led by a Family Foundation grant. Research and G&A together ran a modest (\$57,512) deficit before that gift.
- The leaner FY26 cost base is holding: total expense fell \$431K (-24.5%) year-over-year, with salaries & fringe down \$296K (-28.0%).
- Cash rose to \$3.10M, and new Pacific Ocean Fresh and iAlumbra projects began billing — now carrying \$2.8M of restricted funding to be earned through project work.

Q1 P&L — Q1 FY27 vs. Q1 FY26

July 1 – September 30, 2026 | Company-level QuickBooks



Line Item	Q1 FY27	Q1 FY26	\$ Change	% Change
Contributed Support	\$3,112,005	(\$2,008,339)	+\$5,120,344	n/m
Earned Revenue (grants & contracts)	\$1,174,277	\$1,309,037	(\$134,760)	-10.3%
TOTAL INCOME	\$4,286,281	(\$699,302)	+\$4,985,584	n/m
TOTAL EXPENSE	\$1,331,372	\$1,762,661	(\$431,289)	-24.5%
NET INCOME	\$2,954,909	(\$2,461,964)	+\$5,416,873	n/m

Q1 FY27 Net Income by Class

Class	Net Income
CA Research	(\$91,918)
FL Research	\$27,038
General & Admin	\$7,368
Fundraising	\$3,012,421
TOTAL	\$2,954,909

Fundraising's \$3.01M is primarily the Lund grant, which supports funded project work. Excluding Fundraising, Research and G&A together ran a (\$57,512) deficit. Q1 FY26 contributed support is net negative because of a (\$2.13M) G&A adjustment, so year-over-year income and net income changes are not like-for-like.

Expense Overview — Q1 FY27 vs. Q1 FY26

Same collapsed categories used in the FY26 year-end report

Category	Q1 FY27	Q1 FY26	\$ Change	% Change
Salaries & Fringe (net)	\$760,544	\$1,056,671	(\$296,127)	-28.0%
Equipment & Supplies	\$255,388	\$318,543	(\$63,155)	-19.8%
Occupancy	\$120,528	\$118,391	+\$2,136	+1.8%
Outside Services	\$125,912	\$98,125	+\$27,786	+28.3%
Travel & Meetings	\$10,705	\$22,208	(\$11,503)	-51.8%
All Other (Indirect net / Depreciation / Business)	\$58,296	\$148,723	(\$90,427)	-60.8%
TOTAL EXPENSE	\$1,331,372	\$1,762,661	(\$431,289)	-24.5%

Every category fell except Occupancy (flat) and Outside Services (+\$28K, +28%). Salaries & fringe — 57% of spend — fell \$296K (-28%) after the FY26 right-sizing. All Other is lower partly because FY27 depreciation has not yet been recorded (Q1 FY26 included \$87K).

Program Billings — Q1 FY27

Project invoices by month | Source: monthly Invoices & Prepaids workbooks



	July	August	September	Q1 Total
Invoices mailed (cash receivable)	\$215,456	\$241,562	\$221,192	\$678,210
In-house billings (prepaid draw-down, non-cash)	\$119,177	\$163,458	\$186,886	\$469,521
Total project invoices	\$334,632	\$405,020	\$408,078	\$1,147,730
Indirect cost generated	\$78,548	\$102,414	\$102,271	\$283,232
OREHP (6795, CDF&W) share of invoices	\$177,040	\$174,641	\$175,182	\$526,863

41%

of Q1 invoices were in-house (prepaid draw-down), rising from 36% in July to 46% in September

46%

of Q1 invoices came from one project, OREHP — a concentration to monitor

24.7%

indirect generated as a share of project invoices in Q1 (\$283K of \$1.15M)

Note: July total billings of \$273,588 per the workbook include a documented (\$62,703) reconciling item; project invoices above are shown before that item.

Balance Sheet

September 30, 2026 vs. September 30, 2025 | Company-level QuickBooks



Line Item	Sep 30, 2026	Sep 30, 2025	\$ Change
Checking/Savings	\$3,100,512	\$31,841	+\$3,068,670
Accounts Receivable (net of deferred/restricted)	(\$766,095)	(\$922,297)	+\$156,202
Other Current Assets	\$1,583,971	\$1,414,467	+\$169,504
Total Current Assets	\$3,918,387	\$524,011	+\$3,394,376
Fixed Assets (net)	\$4,652,574	\$4,634,671	+\$17,903
Other Assets	\$12,163	\$12,163	+\$0
TOTAL ASSETS	\$8,583,125	\$5,170,845	+\$3,412,279
Total Liabilities	\$610,920	\$832,158	(\$221,238)
Total Equity	\$7,972,204	\$4,338,687	+\$3,633,517

Key Points

Cash is up \$3.07M to \$3.10M, from the Lund grant and advance project funding.

Liabilities fell \$221K (-27%); no line-of-credit balance is outstanding.

Equity rose \$3.63M, led by Q1 net income of \$2.95M.

Accounts receivable is shown net of \$1.17M restricted contributions and \$122K deferred prepaid grants.

Fundraising & Contributed Support

Q1 FY27 vs. Q1 FY26 | By QuickBooks class



Class	Q1 FY27	Q1 FY26	\$ Change
Fundraising	\$3,021,752	\$44,426	+\$2,977,326
General & Admin	\$59,285	(\$2,134,039)	+\$2,193,324
Research (CA + FL)	\$30,968	\$81,274	(\$50,306)
Total Contributed Support	\$3,112,005	(\$2,008,339)	+\$5,120,344

Major Funding Commitments

Lund Family Foundation — \$3M one-time grant for aquaculture (Pacific Ocean Fresh Phase 1).

CIFARM — NOAA cooperative institute; HSWRI is a partner institution (subcontractor MOUs in process).

HFOF proceeds: \$19,140 received in September.

The Lund grant is a one-time event, not a recurring base. FY26 contributed support was \$985K vs. \$2.94M in FY25. Priority for FY27 remains re-engaging SeaWorld and Chevron or identifying replacement anchor donors. Q1 FY26 reflects a (\$2.13M) G&A adjustment.

Cash Position & Liquidity

September 30, 2026



CASH & BANK, 9/30/26

\$3.10M

vs. \$32K at 9/30/25; \$732K at 6/30/26

RESTRICTED CASH HELD

\$514K

Per prepaid liability schedule

MONEY MARKET (SCHWAB)

\$297K

Up from \$135K a year ago

LINE OF CREDIT

\$0 drawn

\$1.0M capacity available

Liquidity Notes

- Liquidity has moved from a year of bridge financing to a position of strength: cash is \$3.10M and the \$1M line of credit is undrawn.
- Much of the cash is committed. Net prepaid grant liabilities are \$3.2M and must be earned through project work, so unrestricted operating liquidity is well below the headline balance.
- In-house billings (\$470K in Q1) draw down prepaid balances and produce no cash; mailed invoices (\$678K) generate cash. Management will bring a plan for investing surplus balances.

Development Committee

FY26/27 Qtr. 1

Highlights:

- 1st Qtr. Income: \$3,298,065
- Facebook Views and Engagement up
- Many views and new followers
- Posting more frequent stories to Instagram and Facebook
- HSWRI educator honored
- DRAFT Rebrand

Development Income

FY26/27 Qtr. 1

- Individual Gifts: \$2,831
- HFOF Proceeds (less WFF 20%) : \$91,634
- Foundation/Business Gifts: \$3,203,600
\$3,296,085

Social Media Metrics

FY26/27 Qtr. 1



Highlights:

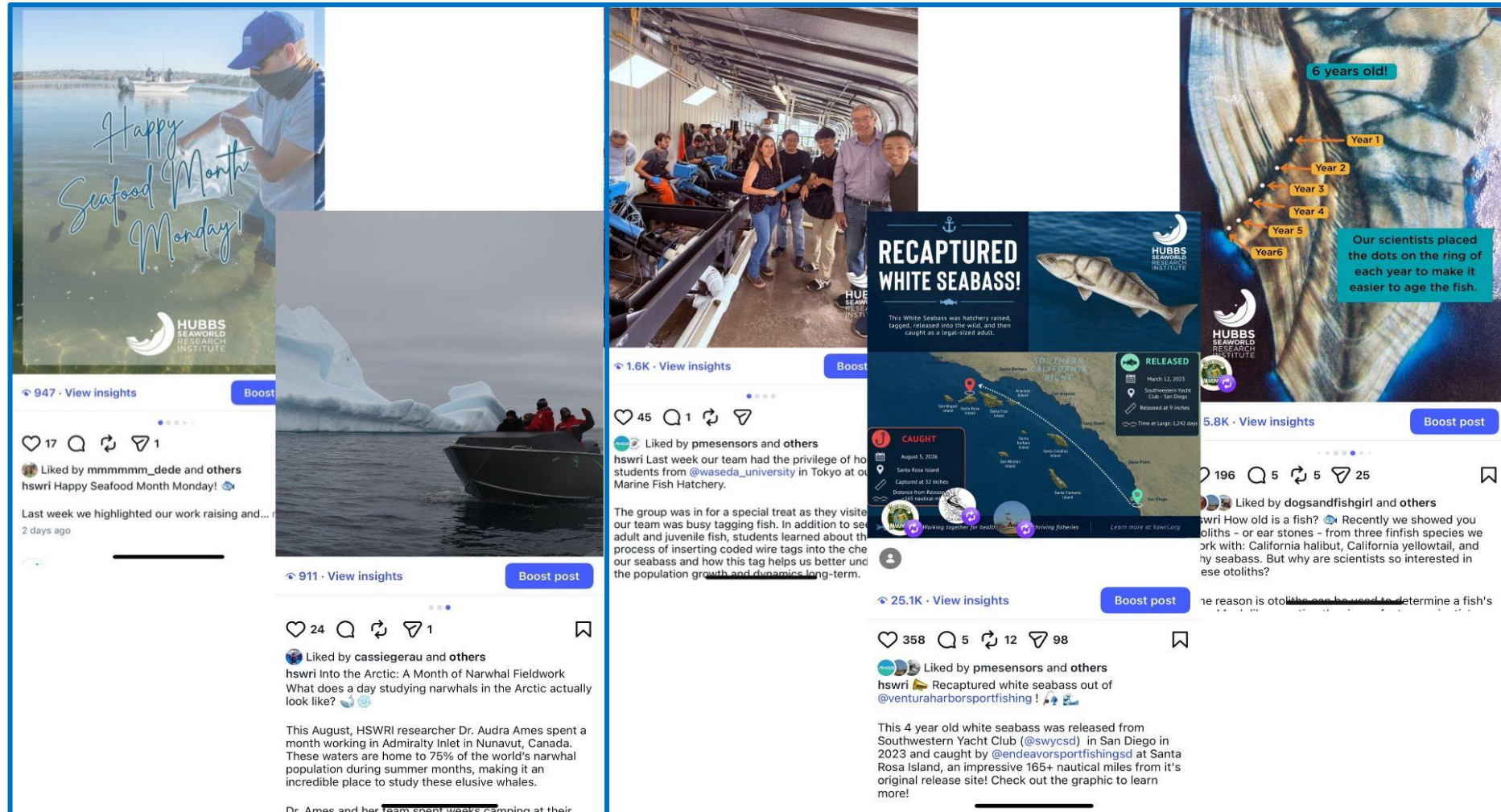
- Facebook Views up 48% and Engagement up 30% since last quarter
- Over 20K views and 45 new followers from new halibut content on Instagram
- Posting more frequent stories to Instagram and Facebook which are having strong engagement specifically from non-followers

Followers:

- LinkedIn: 2,176 Followers (+153)
- Instagram: 5,984 Followers (+614)
- Facebook: 11,515 Followers (+143)
- X: 1,285 Followers

Social Media Metrics

FY26/27 Qtr. 1



Hayley Heiner Honored

Point Loma Nazarene University, Sat. Oct 17, 2026

2026 ENVIRONMENTAL HERO AWARDS

Saturday, October 17, 2026
10:00 - 12:00 PM
Point Loma Nazarene University
Fermanian Conference Center
3900 Lomaland Drive
San Diego, CA 92106

 **TASHA BOERNER**
ASSEMBLYMEMBER, DISTRICT 77



Hayley Heiner
Unsung Hero

Hayley Heiner is the Education and Outreach Manager at Hubbs SeaWorld Research Institute, connecting students and communities with marine science and ocean conservation. She leads Seabass in the Classroom, a multi-county program that brings science to life where students raise fish and learn about marine ecosystems. Hayley is passionate about making marine science accessible to everyone and helping young people see themselves as scientists and environmental stewards. She believes the ocean belongs to us all and that protecting it starts with helping more people build a meaningful connection to it. Previously, she led education programs at San Diego Bird Alliance, and worked at Birch Aquarium at Scripps and for the City of San Diego. She holds a B.S. in Environmental Systems and a minor in Education in Sciences from UC San Diego.



BRAND LANGUAGE STATEMENTS (2016)

OUR PURPOSE *(Why we exist)*

To conserve and renew marine life to ensure a healthier planet.

OUR VISION *(Our long-term impact)*

To steward a healthier planet where humans and marine life thrive together.

OUR PROMISE/ELEVATOR PITCH *(Our core and focus)*

We provide innovative and objective scientific solutions to challenges facing ocean health and marine life in our rapidly changing world.

OUR POSITIONING *(Our position and value in the market)*

To the world, we are trusted experts who apply innovative and objective science to complex challenges facing our rapidly changing planet in order to improve ocean health.

BRAND LANGUAGE PILLARS (2016)

WE ARE DEDICATED PROBLEM SOLVERS

We are devoted to conserving and improving ocean health. We are committed to finding innovative solutions to the challenges of a rapidly changing world.

WE ARE INNOVATORS

Our scientists are on the leading edge of research. We embrace bold science and creative solutions. We are pioneers in our fields of study.

WE ARE TRUSTED

We are a not-for-profit scientific research institute. Our research is conducted with integrity and peer-reviewed. We are unbiased.

WE ARE COLLABORATORS

We cultivate strategic partnerships with like-minded institutions to complement our research in ocean science, conservation and education. Together, we explore opportunities that address emerging needs to maximize solutions.

WE ARE PASSIONATE

Our mission is driven by our passion for the health of marine life. We are committed to being stewards of the ocean and ensuring a healthier ocean. Our work is never done.

REASONS TO BELIEVE (2016)

WILDLIFE POPULATIONS (ECOLOGY)

Examining the interconnectedness of marine life and habitats.

OCEAN HEALTH (PHYSIOLOGY)

Promoting a healthier planet where humans and marine life thrive together.

ANIMAL BEHAVIOR (BIOACOUSTICS)

Using sound to harmonize human and animal interaction.

SUSTAINABLE SEAFOOD (AQUACULTURE)

Feeding a hungry world; restoring depleted fish populations.

EDUCATION AND OUTREACH

Inspiring a love for science and creating future citizen advocates for ocean health and marine life.

STRATEGIC GOALS (2016)

RESTORE WHAT HAS BEEN DIMINISHED

Rebuilding depleted marine populations and restoring damaged habitats.

CONSERVE WHAT IS THREATENED

Protecting vulnerable species and understanding the ecological relationships essential to healthy oceans.

SUSTAINABLY USE WHAT THE OCEAN CAN PROVIDE

Developing approaches to meeting society's needs while protecting marine ecosystems.

INNOVATE FOR THE FUTURE

Transforming scientific discoveries into practical solutions through technology, partnerships, and education.

EDUCATION, WORKFORCE DEVELOPMENT & COMMUNITY ENGAGEMENT

Connecting all four goals through learning, scientific collaboration, and preparation of the next generation.

WHY THE CHANGE?

Purpose:

To move from describing the Institute by its established research disciplines to describing it by the outcomes our science seeks to achieve.

Priority:

Education should remain visible in both the 2016 and 2026 frameworks, reflecting its importance to the Institute's mission.

Conclusion:

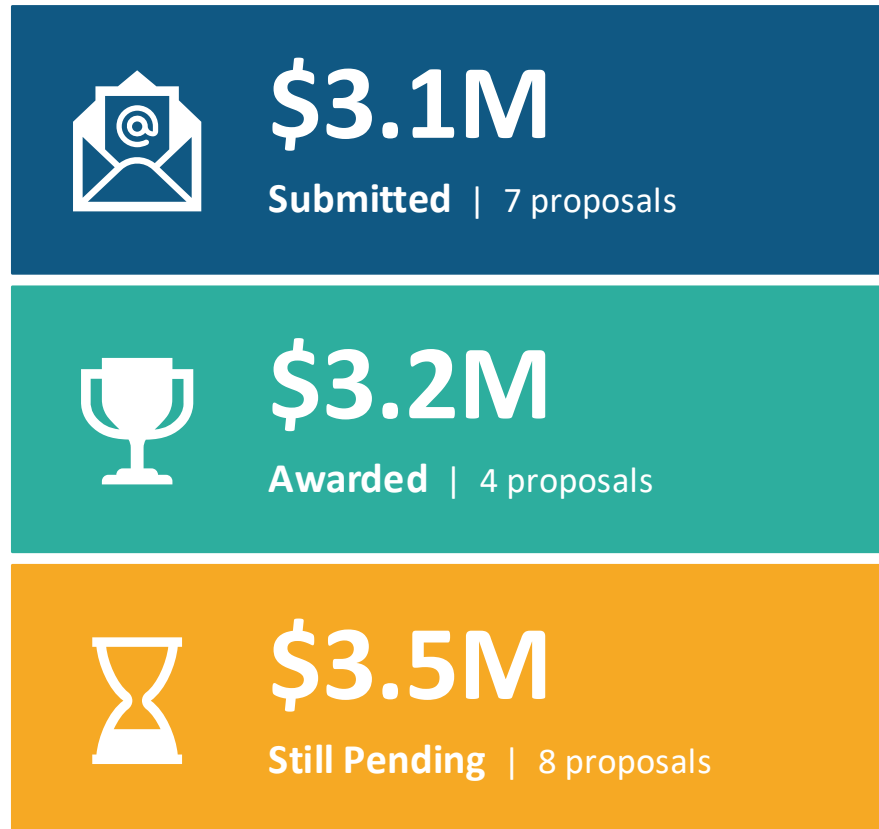
Our scientific mission remains constant, but the language we use to describe our work should reflect the full breadth of our capabilities and ambitions.

Q1 Science Committee Highlights

- Year over year grant submissions ↑ \$2.8M
- Research productivity remains strong
- Aquaculture projects drive our conservation work
- Seabass in the Classroom ramping up
- Presentation: Research Scientist Kevin Stuart

FY27 Q1

Grant Funding



Q1 funding highlights

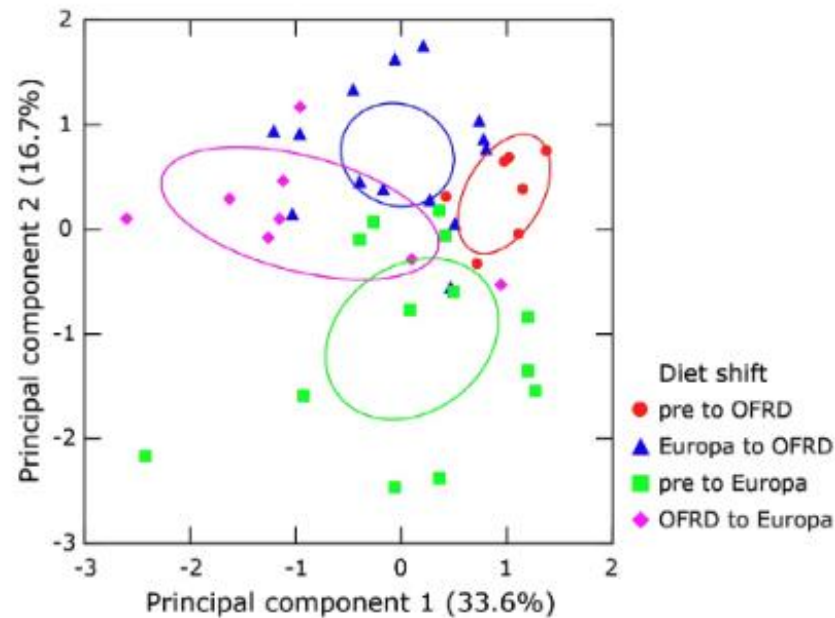
- **\$3M anonymous award** for offshore aquaculture development
- **\$775k submission** to Dorrance Family Foundation to continue support for SeaBass in the Classroom

FY27 Q1

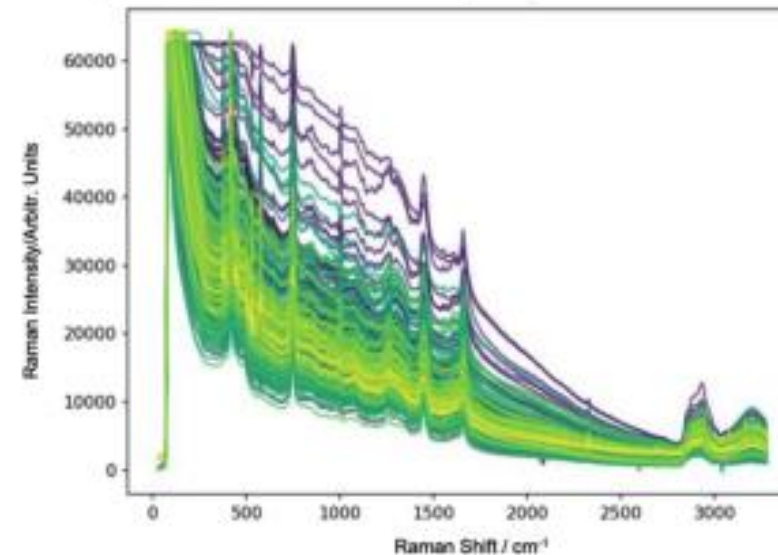
Science Impact



Selected Publications



Evaluation of an open formula reference diet on California yellowtail (*Seriola dorsalis*) Broodstock (Stuart et al. 2026)



Rapid Quantification of Fatty Acids in Fish Eggs Through Raman Spectroscopy. Journal of Raman Spectroscopy. (Panitz et al. 2026)



FY27 Q1

Conservation Impact

Population Enhancement



White seabass released

37,545 **3,060,103**

this quarter total

Halibut released

0 **21,392**

this quarter total

Habitat Restoration



Acres seagrass planted

14 **137**

this quarter total since 2025



Marine Mammal Rescue



Mammal strandings

25 **>2,000**

this quarter total

Dolphin rescues

3

this quarter

FY27 Q1 Education and Outreach

Inspiring a love for science

Summer outreach sustains student access to marine science while SITC prepares to return to classrooms this fall.

SMMILE SUMMER PROGRAM

Hosted the weeklong marine mammal learning intensive for San Diego high school students with priority given to students from underrepresented backgrounds. Featured education & bioacoustics team and an unforgettable student behind the scenes at Wild Arctic experience.



FACILITY TOURS

Welcomed approximately 120 students through the Carlsbad hatchery and Mission Bay laboratory over summer, including an Oceanside High School student visit in partnership with Biocom and a student leaders visit from Ocean Discovery Institute.



SEABASS IN THE CLASSROOM

Fall semester school year begins with many sites receiving their seabass deliveries. 10 schools will be participating this semester: Helix HS, Mar Vista HS, San Clemente HS, El Modena HS, Orange Coast College, Warner MS, Edison HS, Madison HS, Miramar College, and La Costa Canyon



Managing Aquaculture Resources at a Non-Profit

Kevin Stuart – Research Scientist



Hubbs-SeaWorld Research Institute
Board of Trustees Meeting
October 30, 2026

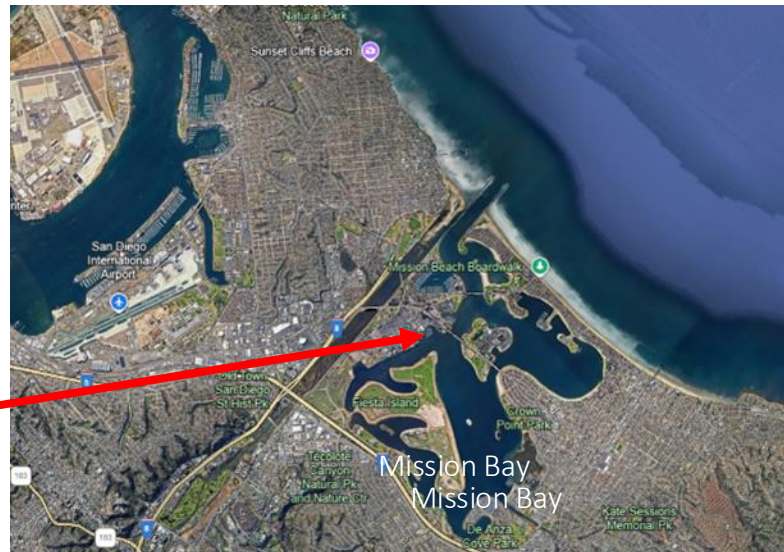
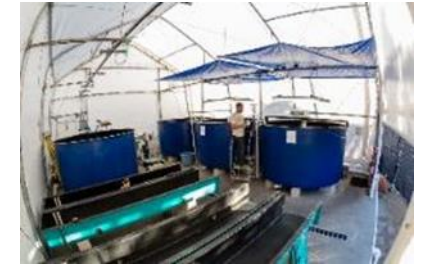
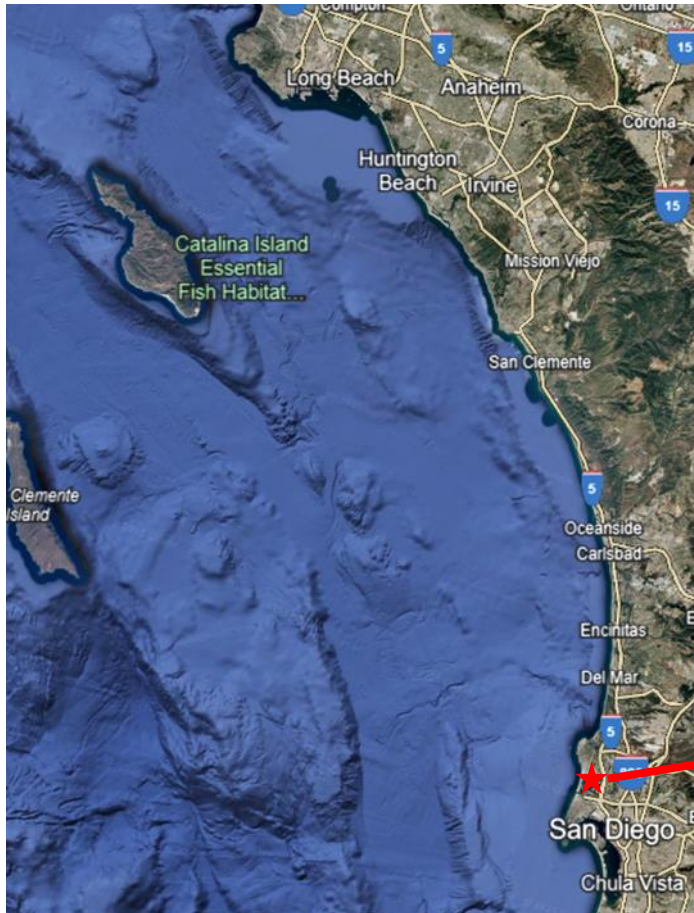
Current Culture Species at HSWRI's Mission Bay Laboratory

- An unprecedented number of organisms are currently being cultured
- Scientific productivity depends on effective and dynamic management of limited resources
 - Space/systems
 - Seawater
 - People
 - Funding
- Each species has its own requirements
 - Spawning seasons
 - Temperature tolerances
 - Feed and nutrient requirements
- Permits and permission requirements add another layer of complexity



SPACE AND WATER

- Operating since 1994
- 30,000 ft²
- 300 gpm seawater system
- ~30% dedicated to aquaculture



Systems



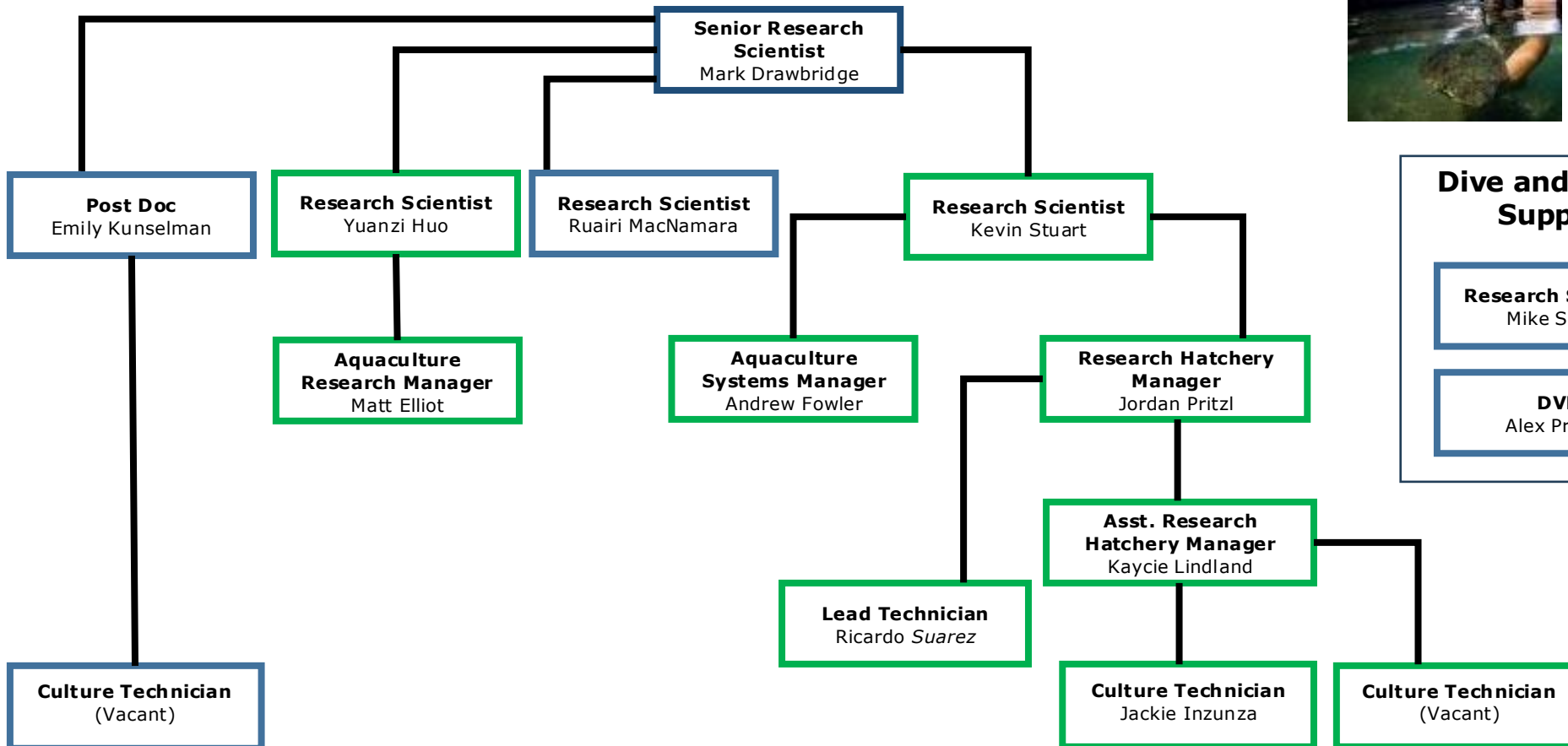
ID	Indoor/Outdoor	Organisms	Life Stage/Function	Volume (L)	Tanks (#)	RAS?	Temp Control?
F-1	Outdoor	Inverts	Growout	1,000	5	N	N
F-2	Outdoor	Fish - Halibut	Growout	1,000	5	Y	Y
T7	Outdoor	Fish -CYT	Brood/Growout	140,000	1	Y	N
YT1-4	Outdoor	Fish - misc	Brood/Growout	10,000	4	N	N
YT5-6	Outdoor	Fish - misc	Brood/Growout	10,000	2	N	N
T4-5	Outdoor	Fish - misc	Growout	8,000	2	N	N
S1-S2	Outdoor	Fish - Halibut	Brood	31,500	2	Y/N	Y/N
S3-S4	Outdoor	Fish - CYT	Brood	31,500	2	Y/N	Y/N
TES	Indoor	Fish - Halibut	Larval	320	12	Y	Y
24-T	Indoor	Fish and Inverts	Larval	320	24	Y	Y
IMTA	Outdoor	Misc	Growout	800/1,000	5/1	Y	N
Tent-1	White tent	Fish - CYT	Larval	5,300/1,000	2/1	N	Y
Tent-2	White tent	Abalone	Brood, larval, growout	600/600	4/4	N	Y*
IBR	Indoor	Oysters	Broodstock	320	8	Y	Y
IL-1	Indoor	Shellfish	Larval	400	4	N	Y
IL-2	Indoor	Inverts	Larval & Juvenile	1,000	3	N	Y
Q-Oyster	Indoor	Oysters	Quarantine	100	3	N	N
Q-Invert	Outdoor	Inverts	Quarantine	600	2	N	N
FLUPSY	Outdoor - offsite	Scallops	Growout			N	N

Systems



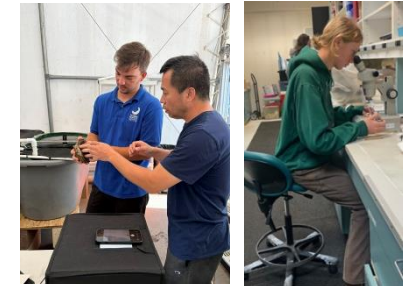
ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
F-1		WSC holding			PCS holding								
F-2						CH Growout							
T7	CYT Growout Study												
YT1-4	CYT Broodstock Holding and Quarantine												
YT5-6									CH Holding				
T4-5										CH Holding			
S1-S2	CH Broodstock												
S3-S4	CYT F1 Broodstock												
TES		CH Larval Rearing											
24-T	Open for CIFARM Work												
IMTA													
Tent-1													
Tent-2	Abalone Conditioning/Spawning/Growout												
IBR				Oyster Spawning and holding									
IL-1							PCS Larval Rearing and Settlement						
IL-2		WSC Conditioning			WSC Larval Rearing and Juvenile Growout								
Q-Oyster	Oyster Quarantine												
Q-Invert													
FLUPSY										PCS Growout			

Mission Bay Aquaculture Staffing



Dive and Health Support

- Research Scientist** Mike Shane
- DVM** Alex Primus



Budgetary/Staffing Considerations

Staff	Halibut ~\$400K (Y-to-Y)	Inverts \$125K (2 of 3)	Inverts & Seaweeds \$200K (4 of 4)	Yellowtail \$213K (1 of 2)	Oysters \$350K/\$150K (1 of 2)	CIFARM \$1,700K/1,000K (1 of 3)
1	26.3%	31.6%	26.3%	15.8%		
2	0.0%	52.6%	47.4%	0.0%		
3	62.8%	18.6%	18.6%	0.0%		
4	23.7%	17.1%	17.1%	42.1%		
5	54.5%	9.1%	9.1%	27.3%		
6	0.0%	23.1%	15.4%	61.5%		
7	52.3%	0.0%	0.0%	47.7%		

Projects that ended in 2026 (\$1.35 million)

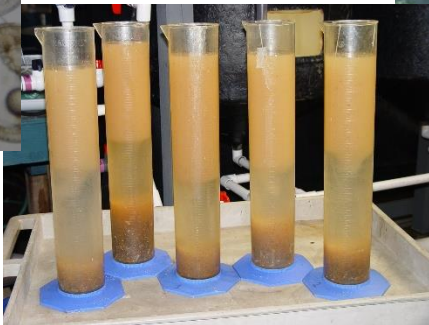
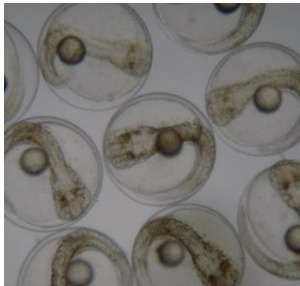
- SK white seabass – \$300K over 2 years
- SK sea cucumber – \$300K over 2 years
- NSG yellowtail – \$538K over 3 years
- NSG yellowtail diet - \$218K over 3 years

Spawning/Egg Production

Spawning

Species	Controlled	Natural	Season
California Halibut		x	Jan - Jun
California Yellowtail	x	x	Mar - Sept
Pacific Calico Scallop		x	Apr - Jun; Oct - Nov
Pacific Oyster		x	Apr - Jun
Warty Sea Cucumber		x	May
Green Abalone		x	Oct-Nov

- Consistent and predictable egg production
- Proper conditioning and nutrition – egg quality
- Need live prey, systems, and labor to be ready when eggs are available



Live Feeds Production

Micro and Macroalgae for Inverts

Primary Stock Cultures

Amphora sp.

Chaetoceros calcitrans

Chaetoceros muelleri

Diacronema lutherii

Dunaliella salina

Nannochloris oculata

Navicula spp.

Rhodomonas spp.

Tetraselmis suecica

Thalassiosira weissflogii

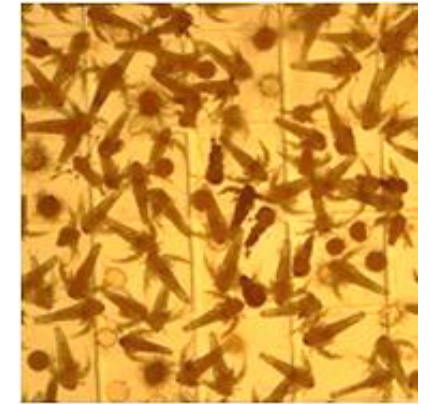
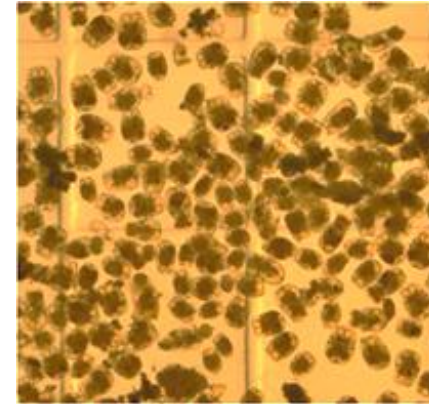
Tisochrysis lutea

Ulva spp.

Devaleraea mollis



Zooplankton for Fish



- High quality and consistent supply of live prey is required
- Each organism and life stage has different nutritional needs

CDFW Regulatory and Permitting Considerations for Collection

- **Scientific Collection Permit**

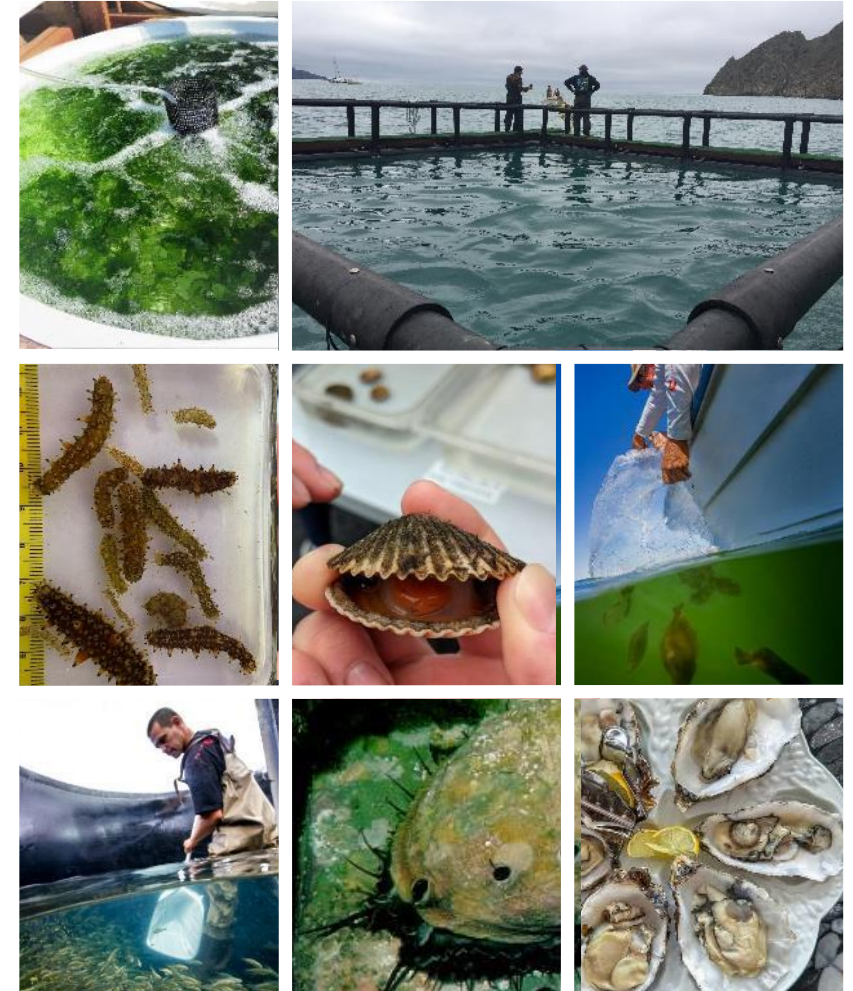
- *allows possession of wildlife for scientific purposes;*
 - *can't sell offspring*
 - *can't consume without special permission*

- **Broodstock Collection Permit** – *allows registered aquaculturists to harvest live, wild aquatic organisms to establish or supplement a commercial domestic breeding population*
 - *Allows sale, consumption, research, transfer between registered facilities*



Future Directions

- Advancing Research and production at HSWRI
 - Improvement to seawater system
 - Improvement in life support monitoring
 - Space for maturation systems, rearing systems, and increased experimental capabilities
- With more capabilities need more people to support the activities
- Industry growth is needed for tech transfer to be realized in the US for all species





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Thank You

Q1 Corporate and Government Relations Committee Highlights

- CIFARM funding should be increased to \$25M annually for the 5 partners to share (DRAFT Programmatic text in packet)
- Permitting for Pacific Ocean Fresh Yellowtail Farm is being reinitiated (HSWRI will own the permits)
- NSF has laboratory improvement funding from which we could fund repairs and renovation support. Requesting \$900K for laboratory improvements
- The Marine Aquaculture Research for America (MARA) Act, has been introduced. Certain problematic requirements (e.g., universities function as co-applicant and operators) are removed

FISCAL YEAR 2027 APPROPRIATIONS REQUEST
National Oceanic and Atmospheric Administration

Name of Request: Cooperative Institute Fostering Aquaculture Research and Markets to support domestic seafood production in the United States through aquaculture

FY 2027 Appropriations Bill: Commerce, Justice, Science and Related Agencies
Specific department/agency: National Oceanic and Atmospheric Administration
Appropriations line item: NOAA National Marine Fisheries Service

Requested amount for FY 2027 appropriations: \$25,000,000

Amount enacted in the FY 2026 Omnibus: \$5,000,000

FY 2027 President's Budget Request: TBD

Background and Significance

According to the National Oceanic and Atmospheric Administration (NOAA), the United States has experienced a perennial seafood trade deficit, growing in the last decade to about \$ 20billion in 2024. NOAA's aquaculture strategic plan has acknowledged that aquaculture systems present a significant opportunity to address these deficits and grow the economy. The four goals of the plan are 1) Manage Sustainably and Efficiently, 2) Lead Science for Competitiveness, 3) Educate and Exchange Information and 4) Support Economic Growth and Viability.

In 2026, NOAA awarded the University of New Hampshire (UNH) the host institution of the Cooperative Institute Fostering Aquaculture Research and Markets (CIFARM). The CIFARM organization incorporates a national approach with a coalition of strong partners including University of Miami (FL), University of Southern Mississippi, University of Hawaii, the Hubbs-SeaWorld Research Institute (CA), along with corresponding state Sea Grant Programs. This approach enables a regional, but collaborative national effort to develop aquaculture to reflect the character of American coastal communities. CIFARM is being lead within the School of Marine Sciences and Ocean Engineering (SMSOE) at UNH with its world-class science and engineering expertise in sustainable seafood systems. UNH is leading the CIFARM effort to expand efforts from the Northeast to the Southeast and Caribbean, the Gulf of America, the West coast and to Hawaii and Pacific Islands.

CIFARM is the preeminent research and development center working with the NOAA Fisheries Science Centers and the Office of Aquaculture to address critical issues associated with economic seafood development with efficient regulatory procedures and sustainable approaches. The tenets of CIFARM will support Executive Order 13921, *Promoting American Seafood Competitiveness and Economic Growth* issued on May 7, 2020. It will also complement efforts within the USDA Office of Seafood and promote the potential Marine Aquaculture for America Act (MARA Act) introduced as [S.2586](#) and [H.R.5746](#) in the 119th Congress) as bipartisan legislation designed to expand commercial-scale, science-based offshore aquaculture in U.S. federal waters (3 to 200 nautical miles offshore. Senate Cosponsors include Brian Schatz (D-HI), Roger Wicker (R-MS) and Jerry Moran (R-KS). House Cosponsors include Mike Ezell (R-MS), Ed Case (D-HI), Kat Cammack (R-FL) and Jimmy Panetta (D-CA).

Appropriations Request

To ensure we are developing the necessary sustainable seafood systems for the future we respectfully request that Congress provides NOAA Fisheries with \$25,000,000. This will enable CIFARM to effectively support the sustainable development of aquaculture in the United States.

DRAFT

Marine Aquaculture Research for America Act (MARA Act)



What it is:

- Bipartisan legislation intended to establish a science-based pathway for developing commercial-scale offshore aquaculture in U.S. federal waters.
- Rather than authorizing widespread offshore fish farming, it proposes using carefully monitored demonstration projects to establish needed regulatory experience for a responsible domestic industry.

Marine Aquaculture Research for America Act (MARA)



What the legislation would do:

- Establish commercial-scale demonstration farms to evaluate environmental effects and operational performance.
- Strengthen NOAA's aquaculture responsibilities, including coordination of permitting and oversight.
- Support aquaculture research and Centers of Excellence, bringing universities, research institutions, and industry together.
- Promote workforce development and working waterfronts, including opportunities for traditional fishing communities.
- Commission independent scientific and regulatory assessments through the National Academies and Government Accountability Office.

Marine Aquaculture Research for America Act (MARA)



What is its future?

- The immediate issue is whether congressional committees will advance the legislation before the 119th Congress ends in January 2027.
- If it does not pass, it would need to be reintroduced in the 120th Congress. Its provisions could also be incorporated into other legislation.
- Its bipartisan sponsorship provides a basis for continued consideration, but sponsorship alone does not establish a timetable for passage.

Marine Aquaculture Research for America Act (MARA)



MARA Act is relevant to 3 HSWRI initiatives:

- *Pacific Ocean Fresh*: MARA's demonstration-farm provisions could provide a future framework for studying commercial-scale offshore production and informing regulations. (MARA's *Savings Clause* prevents overriding POF's permitting process)
- *CIFARM*: Its emphasis on coordinated aquaculture research aligns with the Institute's participation in NOAA's Cooperative Institute.
- *Blue Tech Innovation Center*: Its research, innovation, and workforce-development objectives complement the Center's proposed mission.

A distinction: Our ongoing permitting of Pacific Ocean Fresh does not depend on passage of the MARA Act. The proposed legislation could create additional opportunities and regulatory mechanisms, but it should not be treated as an existing source of permitting authority or funding.

Unusual Public Outreach Request

- Two articles in New York Times (Oct 8) and Los Angeles Times (Oct 9)
- *"The Dirty Secret Behind Farmed Fish"*
- Both based on 2019 study about the problem with fishmeal and fish oil harvests
- At the request of SATS, Don Kent drafted Op-eds to both papers
- Copies of articles and HSWRI responses in the Board packet

The Dirty Secret Behind the Farmed Fish You Eat

Our appetite for seafood is growing. In the last 60 years, the global consumption of fish has more than doubled. As demand has increased, so have dangerous levels of overfishing: One-third of the world's fish stocks are currently being harvested at unsustainable levels.

Fish farming, known as aquaculture, was supposed to help solve this problem by relieving some of the pressure on the planet's oceans.

It is now a vast and innovative industry.

Norwegian companies have built enormous, semi-submersible structures in the open ocean that can house as many as 1.5 million salmon.

In China, huge aquaculture ships are equipped with breeding cabins capable of holding 90,000 cubic meters of water.

Today, more than half of all the seafood that's eaten comes from aquaculture rather than wild catch.

But aquaculture has a dark secret: Most of this farm-grown seafood is raised on other seafood taken from the oceans.

Think about it: Farm-raised fish have to eat something.

The most efficient way to feed them is to sweep up vast numbers of other smaller fish, which are turned into a nutrient-rich powder called fishmeal — or its liquid equivalent, fish oil.

As a result, instead of relieving the pressure of overfishing, aquaculture is making the problem worse.

Those of us who have recently eaten farm-raised seafood are participating in a developing environmental crisis.

That would be bad enough, but the so-called reduction industry driving the crisis also flouts the law and puts people in danger. The production of fishmeal often involves forced labor and has led to worker deaths and the polluting of communities around the world. It has provoked political unrest in places like India and prompted countries to accuse others of violating their territorial waters. Dangerous chemicals, including antimicrobials, fire retardants and anesthetics, are often added to fish ponds and make their way into the seafood.

Some of the most popular types of seafood consumed in the United States — salmon and shrimp — are predominantly imported from farms that use fishmeal. They end up in

supermarkets throughout the country, including popular retailers such as Walmart and Kroger, and appear on the menus of hundreds of thousands of restaurants and cafeterias, including those on Capitol Hill where senators and members of Congress eat lunch.

This article was reported by the [Outlaw Ocean Project](#), a nonprofit organization founded by Ian Urbina in 2019.

But the problem remains mostly invisible to the American consumer, obscured by marketing campaigns that highlight the clever, eco-friendly adaptations of the aquaculture industry. To create a clearer picture of its impact on humans and the planet, we conducted the most [extensive audit](#) ever of the fishmeal supply chain.

A fifth of all fish pulled from the world's oceans is now put to uses other than human consumption — mostly to make fishmeal and fish oil.

Our reporting, which involved dozens of journalists from as many countries, mapped more than 1,400 fishmeal plants and identified more than 2,400 ships connected to fishmeal production. We visited factories and farms; we boarded ships at sea. A team of a half-dozen researchers searched company websites; social media; trade, regulatory and court records; product catalogs; and foreign press reports for visual evidence of the industry's dangers, which we then corroborated with other independent sources.

What we found is that more than 250 seafood companies have had crimes or concerns documented within their supply chains.

In their marketing, seafood companies routinely claim that what they're selling is ethical and sustainable. They tend to focus on the engineering marvel of the farms and ignore the crimes and costs located further upstream in their supply chains. Our goal was to reveal all of those costs in order to understand the dark underbelly of an industry that has become one of the world's dominant food suppliers.

To get the full picture, you have to start on the ships.

ships

The fishing fleets that supply the world's fishmeal industry total more than 10,000 vessels.

These ships primarily target small schooling fish like anchovies, sardines and sprat that are caught specifically to be reduced into feed.

Along some coasts, they also catch larger fish that would otherwise be sold for people to eat.

Some fishmeal is made from the heads, guts and other remains after wild-caught fish have been processed for human consumption.

At any given time, many fishing vessels are operating illegally and taking measures to avoid detection by the authorities. Scientific studies have classified at least half of the species they capture as “overexploited,” or in danger of disappearing. Hundreds of the ships in the global fishmeal fleet are bottom trawlers, using weighted nets to scrape the ocean floor and devastating virtually everything in their path.

Our reporters boarded fishmeal ships from the South China Sea to the far reaches of the North Atlantic. We reviewed logbooks, interviewed workers and documented illegal practices. Hundreds of fishmeal vessels were found to be fishing in closed or protected seas, violating quotas on certain species, or fishing without licenses.

Working conditions on some ships were abysmal. Deckhands described having their passports confiscated, being forced to work 15-hour days, and being beaten by ship officers. On Chinese and Russian ships, we uncovered worker fatalities and injuries and forced labor, including cases of debt bondage and deckhands who asked to leave the ship but were forbidden. Crew on one Chinese ship off the coast of West Africa slept on deck, exposed to waves and rain, or in dangerously hot and cramped quarters filled with exhaust fumes.

Since 2019, more than a dozen people have died working in the fishmeal industry in Peru, which is the world’s largest producer, typically providing more than a fifth of the global supply. Workers on the country’s vessels have sometimes fainted from the toxic gases emitted by the hundreds of tons of decaying fish in their holds. In 2023, two men asphyxiated after they fell into the hold of a ship while unloading anchovies for Copeinca, a major fishing company operating in Peru. (CFG Investment, the company that owned Copeinca at the time, [did not respond](#) to a request for comment. The current owner, the Canadian company Cooke, said the accident was not Copeinca’s responsibility but the fault of the fishermen themselves.)

Other workers fell overboard or were fatally struck by heavy equipment. Also in 2023, a fisherman with another Peruvian company, TASA, died at sea when he was hit by a cable. A spokesman for the company [said](#) TASA “mobilized all necessary human and logistical resources” in response to the accident and provided care to those affected by the death, including psychological support for the family.

Workers are far from the only ones affected. Over the last decade, the fishmeal industry has decimated the food security and livelihoods of coastal communities.

For generations, the waters off West Africa were fished by fleets of brightly painted wooden pirogues and sustained a vibrant industry of dockworkers, traders and transporters, as well as thousands of women who smoked, dried and sold fish in local markets. But scores of fishmeal ships now plunder those waters, sending their catch to dozens of fishmeal factories in Mauritania, Senegal and Gambia.

Though new regulations have limited fishing intensity, Mauritania has been especially attractive because its waters are unusually rich in marine life, fed by a robust nutrient upwelling that the Canary Current generates along the coast. There, Chinese and Turkish ships sweep up bonga shad, sardines, and round and flat sardinella — species known as forage fish, which are toward the bottom of the food chain and are eaten by other marine life or seabirds.

They're also eaten by humans. Such fish are critical to the food security of millions of people in West Africa; sardinella, a small fish that provides an outsize dose of vital nutrients, is among the region's cheapest and most important sources of animal protein. Since the fishmeal industry expanded into West Africa, round sardinella stocks have fallen to their lowest level ever recorded. Today, three of those four species are classified by the United Nations as overexploited.

The fishmeal industry turns cheap sources of food into feed for farmed fish. It takes over 700 wild anchovies to feed one farmed salmon.

Much of the damage being done by the foreign fishmeal ships off West Africa, it turns out, has gone undetected. Ships turn off their transponders or falsify their bearings through “position spoofing” to avoid any meaningful monitoring by local authorities. This practice is especially common off the coast of Mauritania: From 2019 to 2025, at least 21 foreign fishing vessels operating there disguised their location, according to satellite data. Many others routinely engaged in transshipment, the banned practice of transferring fish to refrigeration ships instead of returning to port, thereby skirting local taxes, quotas and regulations for protected species. Fishing vessels can more easily evade this rule if they disappear from satellite tracking.

The Mauritanian government's oversight of its fish stocks and the livelihoods they support has been mixed. While the World Bank in 2025 ranked Mauritania ahead of most African countries at keeping industrial vessels out of protected waters, watchdogs say the government still struggles to determine who is fishing, how much is caught and whether regulators consistently enforce the rules for vessels at sea.

In at least one instance, Mauritania's government appeared to want to keep the problem of illegal fishing quiet. On July 22, 2025, Ali Bakar, an environmental activist in the country,

shared a post to Facebook claiming that a Turkish fishmeal ship was falsifying its location while operating in the Banc d'Arguin National Park, a nature reserve along the country's coast. "It's very likely to be involved in an illegal hunting activity," Bakar wrote. That same day, the police showed up at his home and arrested him.

Charged with "publishing misleading information" on the internet, he was imprisoned, his head was shaved, and he was put in a rat- and roach-infested cell with two dozen others. Unwilling to sign a letter apologizing to the coast guard and the fisheries agency, he was held for roughly two months and then released after pressure from international human rights organizations.

Much like Mauritania, Senegal appears to have little desire to prioritize its people's interests over foreign investment. In 2024, the European Union issued a "yellow card" warning to the country for insufficient cooperation in combating illegal, unreported and unregulated fishing.

The ravaging of these already overexploited fish stocks has been a major driver of migration, according to the United Nations. Thousands of Senegalese fishermen have lost their jobs, prompting many of them to use their boats to flee the country. Typically, they try to make the nearly 1,000-mile journey from Senegal to Europe's nearest touch point, Spain's Canary Islands.

The migration route from West Africa to the Canary Islands has claimed thousands of lives. In September 2024, a fishing boat carrying roughly 100 migrants bound for Spain capsized, killing more than two dozen people. One survivor was Cheikhou Omar, a 21-year-old who made it to shore by clinging to the wreckage for 10 hours. He explained to our reporters how the fishmeal industry played a role in his decision to migrate. "We're fishermen," he told them, "but there's no fish left here."

After the fish are caught, the next step in turning them into feed is to deliver them to one of the 1,400 fishmeal plants around the globe.

During our investigation, we visited plants in Peru, Gambia, India, Indonesia, Mauritania, Senegal and Thailand.

Often found along the coast, these facilities are warehouses filled with huge mounds of decaying fish that are shoveled or backhoed into giant machines that cook, press, dry and then grind them up.

Despite corporate promises that fishmeal plants would create significant numbers of jobs, most of the facilities visited by our reporters had fewer than six workers present at any

given time. Their jobs consisted of bagging the meal, driving forklifts and loading sacks onto trucks and shipping containers.

The cooking and pulverizing of millions of tons of fish creates a rancid, overpowering smell that can harm tourism by scaring off beach visitors and causing restaurants to close. The odor is more than just unpleasant; it's a health hazard. In 2021, two fishermen in Chancay, Peru, died from chemical asphyxiation while unloading a vessel at a fishmeal plant. (The company, Pesquera Caral, [did not respond](#) to a request for comment.)

The unique “fishy” smell from rotting seafood comes from a chemical called trimethylamine, or TMA, which has been found to be carcinogenic. Globally, more than 16.5 million people, including nearly two million under the age of 15, live within a mile of the industry's 1,400 plants.

More than 16.5 million people live within a mile of the industry's 1,400 plants, which emit carcinogenic chemicals.

In India alone, 388,000 people, including thousands of young children, live close to such plants. As of 2022, India was producing more than 300,000 tons of fishmeal annually, at least half of which was consumed domestically, largely to feed the country's shrimp farms. Most of the remaining fishmeal was exported, making India the world's third largest source of the feed.

But that economic success has not prevented fishmeal production from being a source of civil unrest. In recent years, plants in India were frequently the target of protests or strikes that aimed to shut them down. Residents claimed that the odor emanating from the plants was unbearable and caused breathing problems for children, elderly people and pregnant women. Protesters have blockaded roads to stop trucks, clashed with the police and, in one instance, spurred a boycott of local elections.

Such demonstrations sometimes turn violent. On April 19, 2024, the police clashed with protesters seeking to shut down the NPM fishmeal facility and other fish processing plants in the southern state of Tamil Nadu. When residents of one village staged a sit-in protest in the streets, a group of masked men carrying knives, bottles and clubs — thought to be acting at the behest of plant owners — emerged from an S.U.V. and attacked the protesters. Villagers lobbed stones at the S.U.V. and vandalized police squad cars. (NPM [did not respond](#) to a request for comment.)

A fishmeal plant comes with high risk of fire, pollution and civil unrest. The stench of cooking fish emanates for miles in every direction.

The pollution at fishmeal plants goes beyond carcinogenic odors. In November 2020, authorities discovered that four facilities in an industrial area in Goa were disposing of waste into secretly drilled boreholes on their land, contaminating groundwater and sickening livestock and locals. In 2024, sections of the Periyar River in the state of Kerala

frequently turned black, and thousands of dead fish rose to the surface — a pattern that residents said was most likely caused by fishmeal and other factories dumping their waste upstream.

Fire is another hazard at these plants. Fishmeal heats up as it decomposes and can combust spontaneously when stored. Since 2018, there have been at least 20 fires or explosions at fishmeal plants or on fishmeal vessels globally. On Aug. 7, 2023, three explosions at a fishmeal plant in Chimbote, on Peru’s coast, shattered windows of neighboring houses and sent dark smoke billowing into the sky. Angry residents took to the city’s streets in protest. “Don’t murder my children,” one protester’s sign read.

Local officials said they were gathering evidence that the explosions had been harmful to residents. “It must be demonstrated whether there have been any health effects,” an official from the local environmental assessment office told a Chimbote radio station. (An executive at the company that owned the plant, [Pesquera Exalmar](#), said the explosions had occurred strictly within its boundaries and had “no impact on the structural integrity of adjacent homes.”)

Policing the fishmeal industry has proved difficult because the countries in which the feed is produced are typically poor and therefore eager for foreign investment. In Peru, foreign companies control the industry through direct plant ownership and dominant product purchasing power. Some of the biggest players driving global expansion are Cooke in Canada, which acquired Peru’s top fishing company in 2024; Austevoll Seafood in Norway, which owns the major Peruvian producer Austral Group; and several Chinese companies, which claim the bulk of Peru’s catch quota for anchoveta, a species of anchovy. As a result, these outside companies wield undue political leverage when it comes to ignoring rules.

So where does all the fishmeal — produced at such high human and environmental costs — end up?

Mostly in China, India, Indonesia, Vietnam, Bangladesh and Norway, which have turned fish farming into an industrial enterprise.

More than a thousand farm sites dot Norway’s coastline, where companies like Mowi, which controls about a fifth of the world’s farmed salmon business, have bred fish that resist infection.

Robots use underwater lasers to kill sea lice, a parasite that feeds on salmon.

These operations have an immense impact on the world’s ecosystems. At some Norwegian fish farms, a single salmon can eat anywhere from two to more than five times its weight in wild-caught fish. Altogether, the country’s fish farms produce three times as much waste in

a year as the country's 5.6 million residents flush down their toilets, according to a recent report from the Sunstone Institute, a global data science organization. The farms' waste, which consists of salmon feces, rotting carcasses and uneaten feed, mostly cascades to the coastal seafloor, forming a noxious sludge that smothers marine life.

Fish in farms produce waste. Salmon feces and uneaten feed end up forming a noxious sludge on the seafloor.

No country, however, is a larger producer of farmed seafood than China. Remarkably, China has built its aquaculture industry even in its far northwest Xinjiang region, the most landlocked part of the planet. Though just a tenth of Xinjiang's 620,000 square miles are fit for human habitation, the region now hosts roughly 1,000 fish farms. These operations, which include farms in the Taklamakan Desert, China's largest, produce almost 200,000 tons of seafood annually: salmon, trout, crayfish, bass, carp, crab, shrimp and tilapia.

The Chinese government directed the development of inland aquaculture in response to the environmental harms from its earlier fish-farming efforts, which were concentrated along the eastern coast. Through the 1980s and 1990s, local governments converted tidal flats and estuaries into shrimp ponds and marine cages, building hatcheries, feed mills and export infrastructure. But waste runoff from fish farms became a major source of pollution, degrading critical waterways, including the Yangtze River, which supplies much of the freshwater to Shanghai, and the Pearl River Delta, which supplies Hong Kong.

To create fish farms in the Taklamakan Desert, bulldozers flattened and compacted the sand before engineers tapped shallow wells — about six feet deep — to fill artificial ponds with brackish groundwater. Technicians seeded them with microorganisms that adjust the water's chemistry to something closer to seawater, effectively transforming desert groundwater into a marine environment.

China is the biggest producer of farmed seafood in the world. Fish farms abound even in the country's vast Taklamakan Desert.

China trumpets its success in this forbidding region — an undeniable feat. Its state media refers to the desert fish farms as the “blue miracle.” Xinjiang's aquaculture is not merely about producing fish, a column published by the state news outlet CGTN boasted in 2025, but also about the nation's “protein security” and sustaining harmony between people and nature. “From snow-fed rivers to desert oases,” the column said, “Xinjiang has shown that blue dreams can indeed flourish on dry land.”

The company Xinjiang Tianyun Organic Agriculture, one of China's most celebrated success stories, produces seafood that is exported to more than a dozen countries, including the United States. The government aggressively promotes the region's products,

funding media tours of its fish farms for foreign reporters and drawing visitors to what one official has called “Xinjiang’s first cold-water fish theme park,” featuring a museum and a seafood restaurant.

China’s farmed seafood exports have become a source of concern among academic researchers and watchdog organizations for their extensive use of antimicrobials and anesthetics, which are used to ward off disease and keep fish calm in their crowded pens. By 2017, according to a paper in the journal *Scientific Reports*, more than half of all antifungals and antibiotics used in aquaculture worldwide were dispensed at Chinese facilities. Fish farmed this way can pose a health risk to those who consume it.

China calls its desert fish-farming operation the “blue miracle.” State media features people touring the region.

The people who produce this fish in China have faced additional risks. The state has tried to use fish farming, among other industries like cotton growing and tomato farming, to assimilate the non-Han ethnic minorities that predominate in Xinjiang — an effort that has also involved forced sterilization and the suppression of religious practices and native languages. This assimilation has largely been overseen by the Xinjiang Production and Construction Corps, a corporate entity loosely tied to the Chinese Army. The X.P.C.C. is made up of former soldiers turned economic developers and has a notorious international reputation for its coercive tactics. (The X.P.C.C. [did not respond](#) to a request for comment.)

By the time farmed seafood reaches your plate, it bears no trace of the harms to people and the environment that were required to produce it.

More than 80 percent of the seafood eaten in the United States comes from overseas.

Since 2022, the country has been the world’s largest importer of seafood, bringing in enormous quantities of shrimp, salmon, tilapia and catfish.

Only a tiny fraction is inspected on its way into the country.

The United States imports so much seafood in large part because American aquaculture is subject to significant oversight and regulation to protect health, safety and the environment. Federal and state rules dictate where fish farms can be built and the allowable levels of water quality, waste discharge, genetic modification and antibiotic use. These operations end up paying more than their counterparts abroad for higher-quality water treatment systems and testing equipment. Across commonly farmed seafood varieties, including salmon, shrimp and tilapia, domestic brands consistently command a steep price premium over foreign ones — in some cases double the cost.

In recent decades, often in response to public pressure, the American government has started to crack down on illegally or unfairly produced foreign goods, such as diamonds, garments and coffee. But there has been little outcry to date about seafood imports or the government’s performance in policing their origins and quality.

As of now, farmed fish produced using fishmeal is everywhere, sold in big grocery stores like Walmart and Kroger and served in cafeterias — even on Capitol Hill. If in the past year or so you sat down at any of the handful of cafeterias frequented by members of Congress, their staffs, and visitors in town for a tour, there’s a decent chance you dined on farmed seafood produced using fishmeal. Some of it could even have originated in Xinjiang, despite the fact that, in 2021, Congress banned entry of any goods produced “wholly or in part” in the region, on the presumption that such products involve state-imposed forced labor. (The U.S. government has formally characterized China’s actions in Xinjiang as a form of genocide.)

But American authorities inspect only a minuscule fraction of the seafood that is imported by China to the United States. Just this summer, after the Outlaw Ocean Project testified before Congress about the illegal flow of seafood from Xinjiang into the United States, the federal government added another Chinese exporter of farmed seafood to its list of banned companies: Xinjiang Tianyun Organic Agriculture.

Producing about 40 percent of China’s farmed salmon, Tianyun ships its fish through a major Chinese processor, Dalian Rich, which has supplied the American seafood brand Aqua Star, whose products are sold by Walmart and other major outlets, like the food distribution giant Sysco. Food from Sysco goes to nearly every corner of the American marketplace — more than 400,000 businesses in the last six weeks alone — as well as public school cafeterias, federal prisons, military bases and the dining halls on Capitol Hill.

(Xinjiang Tianyun Organic Agriculture [said that it strictly complies](#) with China’s laws on labor and contracts, and that it “has never been involved in, nor will it ever participate in, any form of forced labor.” A Sysco spokeswoman [said the company takes seriously](#) its obligation and commitment to uphold all international and local laws that protect labor, human and child labor rights, as well as the environment. Dalian Rich and Aqua Star did not respond to requests for comment. Walmart confirmed that it sources seafood from Aqua Star.)

Sysco says on its website that its “reputation is built upon the highest ethical standards of business conduct and fair dealing.” But our investigation found that fishing ships that supply Copeinca, the company whose workers died by toxic fume inhalation and that produces fishmeal for shrimp sold by Sysco, were tied to at least 30 fishing violations or

other concerns, including fishing in marine protected areas, exceeding catch limits, and operating without a valid permit. (Copeinca said that it had “all valid permits required under Peruvian fisheries regulations,” and that there were no “final sanctions” on some of these matters because the company was disputing or appealing them.)

The gap between marketing rhetoric and supply-chain realities is common across the industry. Since 2019, at least nine lawsuits alleging false advertising have been brought against seafood companies in the United States. The companies paid more than \$2 million in settlement fees to resolve the cases. Dana Cleaveley, a research consultant formerly with SeaChoice, a Canadian sustainable-seafood group, says that as the public exerts more pressure on the seafood industry to better police supply chains, “investors will begin to see material, not just reputational, risk, and companies will have to adjust.”

The popularity of farmed seafood, in the United States and elsewhere, is only going to grow. The United Nations [predicts](#) that almost two-thirds of seafood eaten worldwide will come from aquaculture by 2035. Most of that production is likely to rely on fishmeal.

One way the industry could adjust would be to farm more seafood that does not need to be fed other fish. Bivalves like mussels, oysters, clams and scallops grow by filtering food from the water, so they don’t require manufactured feed. And where that feed is still needed, it could be made through the more efficient processing of leftovers — wasting less of the fish caught in the wild — and alternative ingredients such as algae, insects and microbial proteins.

Otherwise, the once-glowing promise of fish farming — *grow more fish, catch fewer fish* — is likely to remain broken.

The hidden cost of farmed fish: Pollution, forced labor and the depletion of wild fish



Sahrawis, members of an ethnic group in Saharan Africa, handle freshly caught fish at Laayoune Port in Western Sahara on Oct. 30, 2022.

(KC Cheng)

By Ian Urbina

Oct. 9, 2026 6 AM PT

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- More than half the seafood eaten worldwide is farm-raised, but much of it fed ‘fishmeal,’ a product made from wild-caught fish.

- Farm-raised fish feed millions and the farms provide employment. But a global investigation into fish farming found overfishing, pollution and labor abuses.
- The investigation found that fish farming is often worsening the very problem it hoped to solve and harming the people it was meant to help.

As of 2022, more than half of the seafood eaten worldwide was farm-raised rather than caught at sea, a fact that has been praised as evidence that fish farming can meet a growing demand for seafood while slowing the collapse of the oceans.

But the unbridled embrace of aquaculture as a sustainable answer to feeding the planet ignores some very real costs.

The most popular types of farmed seafood — salmon, shrimp, trout, seabass, seabream — are fed “fishmeal,” a protein-rich powder or pellet made from the kinds of wild fish that aquaculture is thought to save.

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In fact, fishmeal is fed to two-thirds of global farmed fish. Before they reach market, some farm-raised salmon eat more than six times their weight in wild-caught fish.

With thousands of fish farms worldwide, aquaculture provides millions of people with year-round access to affordable protein. Fish farming is also a crucial source of jobs, especially for women in India.

But a wide-reaching [investigation](#) by The Outlaw Ocean Project, a nonprofit news organization based in Washington, D.C., has found that the aquaculture industry’s answer to worries about the world’s oceans — “grow more fish so we can catch less” — is often making the very problem it hoped to solve worse and harming the people it was meant to help.



A worker drives a tractor past mounds of dried and crushed menhaden fish, to be used as animal feed supplements, at the Omega Protein processing plant in Reedville, Va., in 2015.

(Andrew Caballero-Reynolds / AFP via Getty Images)

The investigation

The business of fishmeal — often out of public view — can involve using forced labor, poisoning communities, and eradicating the livelihoods of local fishermen.

Fishmeal production has led to chronic chemical exposure, violent protests — typically spurred by the stench from fishmeal factories — and escalating transnational tensions as countries compete for catch. That price is paid primarily by the poorer countries where the main ingredient of fishmeal is harvested and processed.

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The Outlaw Ocean Project mapped roughly the entire global fishmeal industry, including more than 1,400 fishmeal factories across 64 countries. The effort involved dozens of journalists from over 15 countries who visited factories and farms and boarded fishmeal ships at sea.

Using certification documents, ownership records, trade data, audits and government lists of licensed fishing ships, the reporting team was able to connect ships to the plants they

supplied and pin down which species were being targeted for fishmeal. This allowed them to determine which fishmeal plants were connected to ships engaged in illegal or unsustainable fishing. Then, they traced the fishmeal to the fish farm and to where the seafood was sold by retailers.

The investigation found that more than 2,400 ships tied to fishmeal production, operating in the waters of at least 30 countries. It found that most of those ships do not fully comply with the Global Charter for Fisheries Transparency, a guide created by leading ocean-focused civil society groups detailing accountability standards for industrial fishing fleets.

For example, less than 30% of the fleets had publicly available location information, and less than 25% had a unique vessel identification number. Such opacity makes the ships difficult to police.



Workers sort rainbow trout by weight at a fish processing plant in Murmansk, Russia, in 2019.

(Andrey Rudakov / Bloomberg via Getty Images)

At least half of the species landed by the assessed fishmeal vessels are classified by scientific studies as “overexploited” or worse. Most of these vessels are purse seiners or

trawlers, which deploy vast nets to capture dense schools of fish. Both gear types are associated with high levels of waste, routinely hauling in large volumes of non-target species.

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At least 165 of the ships were bottom trawlers, a particularly destructive form of fishing that uses weighted nets that scrape the ocean floor, destroying virtually everything in their path.

Concerns about aquaculture extend far beyond the fate of the oceans. In [Gambia](#) and [Mauritania](#) in western Africa, the industry drives food insecurity as fish that once sustained local communities are diverted into fishmeal factories.

In remote islands in Russia's far east and in China's Xinjiang region, the reporting detailed the use of forced labor on ships, farms and in factories. In other countries, including [India](#) and [Peru](#), this industry was tied to at least 80 incidents of civil unrest, some violent, usually in the form of labor strikes and protests sparked by the water pollution or the stink from factories cooking tons of decomposing fish.



Anchovies are harvested about 5 miles off the coast of Peru's Lima province on Nov. 19, 2023. Peru is a leading producer of fishmeal and fish oil.

(Ernesto Benavides / AFP via Getty Images)

In [Chile](#) in 2024, several hundred demonstrators burned tires and blocked coastal highways and railway tracks to protest the early closure of the fishing season, a move partly driven by overfishing tied to fishmeal.

In [Senegal](#), fishmeal has put local fishers out of work, so they increasingly are selling — or repurposing — their boats to ferry migrants to Spain’s Canary Islands, a stepping stone to Europe. This perilous journey of roughly 930 miles claimed more than 3,000 lives in 2025.

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“We’re fishermen, but there’s no fish left here, so we left,” said Cheikhou Omar, a 21-year-old fisherman in 2024 as he sat on a beach in Senegal, rescued after the fishing boat he tried to sail to Spain capsized, killing 30.

The fishmeal industry also contributes to transnational tensions. For example, in 2021, a dozen Turkish bottom trawlers fishing illegally in the Aegean Sea tried to [ram](#) a Greek research vessel when the scientists began filming their activity.

In 2018, riots broke out in Saint-Louis, Senegal, after a fisher was shot and killed by Mauritanian coast guards, during what the Mauriticians said was a cross-border raid by a fishmeal boat.

The politics of protein

In her 2021 book “The Fishmeal Revolution,” Kristin A. Wintersteen traces how the Humboldt Current — a cold, nutrient-rich upwelling system along the Pacific coast of South America — was reimagined as a protein mine. That shift, she argues, turned Peru into a fishmeal superpower, responsible for roughly a quarter of worldwide production.

Fishmeal helped fuel the post-World War II expansion of industrial chicken and hog farming, particularly in Europe and the United States. Since then, this model has spread worldwide.



Crew members work on an anchovy boat about 5 miles off the coast of the Peru's Lima province on Nov. 19, 2023.

(Ernesto Benavides / AFP via Getty Images)

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The feed industry has emphasized that it is decreasing its reliance on fishmeal and fish oil — and especially the use of whole fish or fish parts that can be eaten by people. However, as aquaculture grows, global fishmeal production is predicted to rise by nearly 10% by 2032, according to the Food and Agriculture Organization, a United Nations agency.

For example, five of the world's largest salmon companies increased their use of fishmeal and fish oil made from whole wild fish by as much as 39% between 2020 and 2024, according to a report from the Farm Animal Investment Risk and Return Initiative.

Asked about sustainability concerns tied to her industry, Véronique Jamin, a spokesperson for [IFFO](#), the international fishmeal association, said that fish farming is “the most efficient animal protein system.” She added that her organization’s “role is not to advise which markets should use fishmeal and fish oil.” Attempts to make the industry more sustainable

must consider market forces, she said, and seafood companies have to respond to “what people actually want to buy and eat.”

Efforts to move away from fishmeal and fish oil have struggled. Researchers have identified potential alternatives — including seaweed, cassava waste, single-cell proteins produced by fungi and even sewage.

But none are being produced affordably at scale, and the alternatives often lack the nutrients that support the growth of farmed fish.

The role of forced labor

For those toiling at fishmeal plants and fish farms, the work and conditions can be brutal, the investigation found.

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In [Russia](#), fish processing workers were held captive in secluded company towns or stuck on ships far from shore. “People have nowhere to go, no money,” one worker told President Vladimir Putin, who participated in a call-in television show about the fishmeal plant in 2016. A second worker pleaded: “Please, help us.”

In China, the aquaculture industry is expanding rapidly in the country’s mountainous and desert areas inland, particularly in Tibet and Xinjiang, two areas known for political repression, with criminal penalties for speaking native languages or practicing religious or cultural traditions.

Because the U.S. government found human rights abuses to be pervasive there, Congress enacted a law in 2021 that banned all goods produced “wholly or in part” by workers in Xinjiang or by ethnic minorities from the region on the presumption that they were made with state-sponsored forced labor. No such law exists for Tibet.



Fishermen pull a net of fish caught from ice-covered Bosten Lake Jan. 18 in the Xinjiang Uyghur Autonomous Region of China.

(Nian Lei / VCG via Getty Images)

The investigation mapped more than 1,000 fish farms in Xinjiang and Tibet that produce an estimated half-billion dollars' worth of seafood annually, much of it exported to more than a dozen countries, including the United States. Despite the 2021 law banning goods from Xinjiang, the investigation found that farm-raised fish from that region have [reached the United States](#).

For example, the Xinjiang Tiayun fish farm, which produces 40% of China's domestically produced salmon, is tied through supply agreements to a brand of seafood called Aqua Star sold by Walmart and the world's largest food service company, Sysco, which in the U.S. distributes to public schools, military bases and congressional cafeterias.

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Sysco said it was unaware of the link to Xinjiang. "We hold all suppliers across our global supply chain accountable" to uphold U.S., international and local laws, and [Sysco](#)

suspends contracts when they do not, said Ramit Plushnick-Masti, a company spokesperson. Aqua Star and Walmart did not respond to a [request](#) for comment.

[Xinjiang Tianyun](#) said in a statement that claims of forced labor “are completely factually unfounded.” The Chinese government did not respond to a [request](#) for [comment](#).

More than 80% of seafood eaten in the U.S. is imported, and 9% of that comes from China.

Another major supplier of seafood to the U.S. is India, which produces roughly a third of the shrimp that Americans consume, almost all of it grown with fishmeal. The investigation found at least 18 instances of civil unrest and at least 20 cases of water or air pollution tied to Indian fishmeal plants.

In November 2020, Indian government investigators found hidden bore holes where the operator of the United Marine Products fishmeal plant in Goa had been covertly disposing of toxic waste, thereby contaminating groundwater. The plant owner denied wrongdoing.

Shrimp sold by Sysco and at Kroger and Safeway is fed fishmeal from United Marine, according to [Bait to Plate](#), an online tool that maps seafood supply chains. Kroger and Safeway’s parent company, [Albertsons](#), did not respond to a request for comment.

Sustainable practices

Though problems with fish farming have arisen worldwide, for some countries, it aquaculture has been a boon.

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An aerial view shows workers spreading and drying small fish on traditional bamboo racks under the sun in Bangladesh on Sept. 4.

(Muhammad Amdad Hossain / NurPhoto via Getty Images)

In Bangladesh, aquaculture has driven down the price of fish. Even accounting for fishmeal and transportation to the U.S., the production of certain farmed fish, including tilapia and Atlantic salmon, emits less greenhouse gas per pound than beef or pork.

Harvesting bivalves, like clams, oysters, scallops and mussels, is especially sustainable because these species do not require feed. This type of aquaculture also has a low carbon footprint and the shells function as a form of carbon capture, according to a 2020 paper by the scientific journal *Nature Food*.

In the United States, at least 16 factories processed fishmeal as of 2025, along the Chesapeake Bay in Virginia, the Gulf Coast in Mississippi and Louisiana, and in California, Oregon and Alaska.

Most of these factories use inedible offcuts from fishing because nearly every U.S. state has outlawed the targeting of whole fish for fishmeal. The factories also tend to be better regulated than plants elsewhere in the world.

Long supply chains

As the production of seafood has become more globalized, its supply chains have stretched longer, making it tougher for consumers and grocers to know whether it was harvested sustainably or legally.

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Robert K. Stumberg, professor at Georgetown Law and supply-chain expert, said grocers typically buy from wholesalers and rarely track their suppliers. One other reason may be plausible deniability, he added. “Companies can escape blame or the need to fix problems if they’re unaware of them.”



A woman sells fish in Port de Pêche, a port in Nouakchott, the capital of Mauritania, on Feb. 7.

(KC Cheng)

With government oversight of supply chains sometimes lacking, industry-led certification programs have sought to fill the gap and root out unsustainable, unethical or illegal practices.

But critics say these programs generally focus on environmental crimes and overlook labor abuses on ships. On land, at processing plants or farms, certification programs rarely conduct true spot checks to authenticate the reassurances given by managers, said Allie Brudney, a senior staff attorney at Corporate Accountability Lab, a strategic litigation nonprofit.

Instead, the programs frequently alert companies before inspectors show up. At sea, these programs often rely on self-reported information from ship captains rather than having auditors inspect vessels offshore.

Devan Meserve, a spokesperson for the Global Seafood Alliance, which runs the Best Aquaculture Practices program, defended the value of such inspection programs. She [said](#) that her organization represents the “most comprehensive program for farmed seafood,” partly because it covers the “entire aquaculture production chain.”

Protecting workers on the fishing vessels that supply feed mills is, however, an “immense challenge,” Meserve added, because audits occur at port. She added that her organization helps the industry counter illegal and overfishing by requiring feed mills to source most of the fish they use in fishmeal or fish oil from fisheries accredited by certification programs like Marine Trust and Marine Stewardship Council.

The risk of false advertising

“Any accounting of the true impact of aquaculture has to start not with the farm, but with the feed,” said Daniel Pauly, project director of the Sea Around Us initiative at the University of British Columbia. “And that kind of accounting offers a very different picture than the industry offers.”

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Since 2020, at least nine lawsuits alleging false advertising have been brought against six seafood companies in six U.S. states. Plaintiffs challenged language such as “sustainable,” “eco-friendly” and “wild-caught,” as well as claims of superior worker-safety standards.

Five of the lawsuits resulted in settlements, and the companies paid the plaintiffs more than \$2 million.



Sahrawi fishermen offload a fresh catch at the Port of Laayoune in occupied Western Sahara on Nov. 2, 2022.

(KC Cheng)

In at least four cases, the use of fishmeal or fish oil and their link to industrial fishing and ecosystem depletion were central to arguments that the products were not environmentally sustainable. Additional allegations included forced labor on fishing vessels and reliance on harmful pesticides and antibiotics.

The Outlaw Ocean investigation assessed more than 500 seafood companies that made marketing claims that were comparable to — or stronger than — those cited in the lawsuits. Over half of those companies had supply chain ties to fishmeal producers involved in crimes, misconduct and unsustainable fishing practices.

Dana Cleaveley, a research consultant formerly with SeaChoice, a Canadian sustainable-seafood group, said that many industries have already had to begin reckoning with the

human rights and environmental abuses buried in their supply chains. She cited “sweatshop garments,” “fair-trade coffee” and “blood diamonds” as examples.

Seafood has been slower to face such scrutiny, though, as the world leans further into aquaculture, that may change, she said, particularly if more governments begin restricting imports tied to illegality or unsustainable practices. She added: “That’s when investors will begin to see material, not just reputational risk, and companies will have to adjust.”

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But in some quarters, the troubling costs of fish farming remain unaddressed.

In April 2025, President Trump signed Executive Order 14276, “Restoring American Seafood Competitiveness,” which instructed government officials to reduce regulatory burdens and boost the commercial fishing and aquaculture sectors in the United States.

It made no mention of feed or fishmeal.

Urbina is executive editor of the Outlaw Ocean Project. The reporting for this story was part of a larger [investigation](#) conducted by an international [team of journalists](#) based at the Outlaw Ocean Project.

The Future of Seafood Depends on Getting Fish Farming Right

By Don Kent, President and Chief Executive Officer, Hubbs-SeaWorld Research Institute

A recent investigation into the global fishmeal industry exposed troubling practices, including illegal fishing, environmental damage and the exploitation of workers. Those abuses demand action, but the investigation also makes the case for expanding responsible seafood production in American waters. The larger question is: How can we produce enough nutritious food for a growing population without further damaging the natural systems on which we depend?

I have spent more than half a century working in marine science. One conviction has guided my career: Science must do more than identify problems. It must help solve them.

At Hubbs-SeaWorld Research Institute, much of our work has addressed the consequences of humanity's use of ocean resources. Consider the accidental entanglement of marine mammals and other wildlife in commercial fishing gear. It is a serious problem, and researchers have devoted considerable effort to reducing it. But recognizing those impacts did not mean concluding that commercial fishing should cease. It meant developing better practices and technologies so that fishing and marine life could coexist.

That is the essence of sustainable development: finding ways to use natural resources while maintaining the ecosystems on which wildlife and people depend. And solutions must be commercially viable, or they will not endure. We should apply the same standard to aquaculture.

The world's population is expected to approach 10 billion by midcentury. Feeding it will require more than catching additional wild fish or expanding conventional agriculture indefinitely. According to figures compiled by the United Nations Food and Agriculture Organization and analyzed by Our World in Data, agriculture already occupies roughly 45 percent of Earth's habitable land, much of it devoted to grazing animals or growing their feed. Agriculture also accounts for the largest share of global freshwater withdrawals.

Meanwhile, oceans cover about 71 percent of the planet. That does not mean every stretch of ocean is suitable for farming. It does mean we should examine carefully where marine food production can complement food grown on land.

We have learned to farm the land. Why has the U.S. been so reluctant to farm the sea?

Fish offer biological advantages as food animals. Because they are buoyant and most do not expend energy maintaining a constant body temperature, many species convert feed to edible protein efficiently. Depending on the species and production system, farmed fish can have a substantially smaller land and greenhouse-gas footprint than beef. Shellfish

and seaweeds offer further opportunities: oysters and mussels filter naturally occurring plankton, while seaweeds use sunlight and dissolved nutrients rather than manufactured feed.

None of these benefits make aquaculture impact-free. However, careful site selection and proper management can minimize environmental impacts. Responsible feed sourcing, strong labor standards and supply chain accountability are equally important. The proper response is rigorous science, enforceable standards and continuous improvement, not the assumption that ocean farming itself is unacceptable.

Wild-capture fisheries will remain indispensable to food security and coastal economies. But many fish populations already face substantial pressure, and additional fishing cannot meet all future demands. Aquaculture is a complementary source of seafood, not a replacement for fishing. In 2022, for the first time, global aquaculture produced more aquatic animals by weight than wild-capture fisheries, according to the United Nations Food and Agriculture Organization.

The problems exposed in the global fishmeal industry underscore why responsible sourcing and strong oversight are essential to ensuring a sustainable industry. Some feeds still rely on ingredients made from wild-caught fish, and poorly governed supply chains can result in serious harm. But environmental necessity and economics are powerful incentives for change: supplies of wild fish used in feed are finite, and scarcity or overharvesting can drive prices to levels that make traditional fishmeal and fish oil increasingly unattractive to feed manufacturers. Researchers and producers are already developing sustainable alternatives using fish-processing byproducts, crops, algae, insects and microbial fermentation. Market incentives and scientific innovation can reinforce one another, provided we also insist on responsible sourcing and protection of marine ecosystems.

The U.S. is well positioned to demonstrate how responsible aquaculture can be done. As one of the world's largest seafood importers, we depend heavily on production and supply chains beyond our borders, where environmental protections, labor standards and enforcement can vary considerably. That dependence makes expanding seafood production here in our own waters, under strong environmental and labor standards, especially urgent.

We should not respond to troubling practices abroad by turning away from aquaculture altogether; we should respond by setting a global standard for it. With our extensive ocean resources, world-class marine science and engineering capabilities, and institutions experienced in environmental monitoring, the U.S. has the resources to responsibly grow more seafood in our own waters. My home state of California, with its exceptional

scientific talent and deeply rooted environmental ethic, has an important role to play, alongside other coastal states, in advancing that effort.

Federal dietary guidance has long recommended that Americans eat more seafood, and the latest guidelines released this year place greater emphasis on fish and shellfish as part of a healthy diet for both adults and children. But as Americans are encouraged to consume more seafood, an important question remains: Where will the additional supply come from? Wild fisheries cannot simply double their catch. We can deepen our reliance on imported seafood or develop the capacity to produce more of it responsibly in American waters, working in complement with our nation's wild fisheries.

During my two three-year terms on NOAA's Marine Fisheries Advisory Committee, including service as the first chair of its aquaculture subcommittee, I saw the importance of linking sound science with practical national seafood policy. We need rules that protect public resources while giving responsible producers a workable path to demonstrate their methods and improve them.

The proposed Marine Aquaculture Research for America (MARA) Act points toward one such approach by supporting research and commercial-scale demonstration of marine aquaculture in federal waters. We should use the best available science to identify sites with the lowest foreseeable environmental risks, carefully evaluate proposed technologies and establish enforceable monitoring requirements. But science also depends on observation. We cannot learn everything about the performance of marine farms from models or predictions alone. Carefully selected and monitored demonstration farms can provide the real-world evidence needed to improve future siting, refine farming practices and further reduce environmental impacts. Not every site is suitable, and not every farming method should be approved.

Potential environmental impacts are reasons to study, site and manage farms carefully, not grounds for ruling out responsible food production altogether. We regulate agriculture to manage its impacts, not to prohibit farming. Marine farming deserves the same science-based approach.

Every form of food production has consequences. The meaningful question is how to meet human needs while reducing those consequences, protecting biodiversity and sustaining livelihoods. We cannot feed tomorrow's population simply by catching more wild fish, clearing more forests or drawing down more freshwater.

We should insist on accountability when seafood production causes harm. We should also insist on innovation when science offers a better way. The future of seafood depends on doing both.

Don Kent is the President and Chief Executive Officer of Hubbs-SeaWorld Research Institute, a nonprofit marine research organization based in San Diego, California. He has more than 50 years of experience in marine science and aquaculture, beginning his career in 1974 at the San Diego State University in a NOAA Sea Grant-funded laboratory housed at Scripps Institution of Oceanography. He also served two terms on NOAA's Marine Fisheries Advisory Committee, including as the first chair of its aquaculture subcommittee. Hubbs-SeaWorld Research Institute is pursuing federal permits for Pacific Ocean Fresh, a proposed commercial-scale offshore finfish farm in Southern California. The project is undergoing environmental review under NEPA, including preparation of a draft Environmental Impact Statement for public review and comment, and is intended to advance both sustainable seafood production and the science supporting responsible offshore aquaculture.

California Should Be Leading the Future of Sustainable Seafood, Not Sitting on the Sidelines

By Don Kent, President and Chief Executive Officer, Hubbs-SeaWorld Research Institute

A new investigation into the global fishmeal industry exposes serious problems, from overfishing and pollution to the exploitation of workers. These findings deserve attention and corrective action, but they also present an opportunity for states like California to demonstrate how responsible seafood production in ocean waters can be part of the solution.

California has long been a leader in environmental protection, marine science, and agricultural innovation. Our research institutions have helped advance our understanding of ocean ecosystems, sustainable food production and the technologies needed to reduce environmental impacts. And our state already has an established aquaculture industry, with fish raised in land-based ponds and tanks, and shellfish grown in coastal waters. But to date, we have not extended that same innovation to farming fish in deeper waters off our coast.

This is a missed opportunity, both for our state's economy and for the future of sustainable seafood.

By 2050, the world's population is expected to approach 10 billion. With land and freshwater resources growing scarce, and many wild fish populations already harvested at or beyond sustainable limits, we need to find new ways to meet the growing demand for protein sustainably.

Working in complement with our nation's terrestrial farming and commercial fisheries, responsibly managed marine aquaculture provides an opportunity to produce more nutritious food to feed our families without clearing additional forests, converting more land to pasture, or placing comparable demands on limited freshwater supplies.

Fish are also remarkably efficient producers of animal protein. Because they are buoyant and generally do not expend energy maintaining a constant body temperature, many species convert feed into edible protein more efficiently than terrestrial livestock. Research has demonstrated that responsibly farmed seafood can have substantially lower greenhouse gas emissions than beef, and in some cases pork.

Shellfish and seaweed farming offer additional environmental advantages. Mussels, oysters, and clams require no manufactured feed, obtaining their nutrition from naturally occurring plankton. Seaweeds likewise grow without agricultural fertilizers or freshwater irrigation.

The investigation into the global fishmeal industry appropriately questions the use of wild fish to produce aquaculture feeds. But this is precisely where scientific innovation is making progress. Fish-processing byproducts, agricultural proteins, algae-derived oils, insects, and microbial proteins are increasingly being used or developed as alternatives to conventional fishmeal and fish oil. Continued research, responsible sourcing, and enforceable environmental standards are essential to reducing the industry's dependence on wild-caught forage fish. California's research institutions and innovative agricultural sector are well positioned to help further advance these solutions and put them into practice.

The solution to problems in aquaculture is better aquaculture, not abandoning ocean farming.

For Americans, and particularly Californians, the issue has another important dimension: seafood security.

The United States imports more than \$20 billion in seafood annually, despite possessing the world's largest Exclusive Economic Zone (EEZ), encompassing approximately 4.4 million square miles of ocean. NOAA Fisheries previously identified 10 Aquaculture Opportunity Areas (AOAs) in federal waters off Southern California, areas deemed environmentally and economically sustainable for open ocean aquaculture. These areas sit off California's coast, but without a clear regulatory pathway, development in these areas remains hindered.

With much of the seafood Americans consume produced abroad, the environmental protections, labor standards, and supply-chain transparency can be less rigorous than those required of domestic producers. Expanding responsible seafood production in American waters would strengthen our domestic seafood supply, support coastal economies, and create new jobs across the seafood supply chain. For California, that means new economic opportunity for working waterfronts, ports, and the research and technology sectors already based in the state. It would also give us greater oversight of how the seafood we consume is produced.

California should be leading the nation in the development of environmentally responsible marine aquaculture. With its extraordinary scientific and technological resources, world-class research institutions, innovative agricultural industry, and deeply rooted environmental ethos, California is uniquely positioned to demonstrate how seafood production and ocean conservation can advance together. Yet rather than harnessing these strengths to pioneer a new generation of sustainable ocean farming, California has allowed regulatory uncertainty and institutional inertia to constrain the industry's development.

We should be setting the global standard for responsible marine aquaculture, not standing on the sidelines while other nations develop the technologies, industries, and seafood supplies of the future.

The bipartisan Marine Aquaculture Research for America (MARA) Act, introduced in Congress with support from California Representative Jimmy Panetta, would help advance a science-based pathway for responsible open ocean aquaculture in United States waters. This legislation would enable marine aquaculture to move from scientific research and planning into commercial production, giving the United States an opportunity to demonstrate that we can responsibly grow more seafood in our own waters while advancing American leadership in sustainable seafood production.

We regulate terrestrial agriculture to manage its environmental impacts while enabling the production of food. Marine aquaculture deserves the same science-based approach. Appropriate siting, environmental monitoring, responsible feeds, and enforceable operating standards can allow seafood production while conserving marine ecosystems.

The question should not be whether aquaculture has environmental impacts. Every form of food production does. The question is how to produce the food humanity needs with the least environmental cost. And California should be at the forefront.

We cannot feed tomorrow's population simply by catching more of yesterday's wild fish, clearing more forests, or consuming more freshwater. The future of food must include responsible ocean farming. The scientific knowledge exists, the technology is advancing, and the need is undeniable. What remains is the willingness to put these resources to work.

It's time for California to help set the global standard for responsible marine aquaculture.

Don Kent is the President and Chief Executive Officer of Hubbs-SeaWorld Research Institute, a nonprofit marine research organization based in San Diego, California. He has more than 50 years of experience in marine science and aquaculture, beginning his career in 1974 at the San Diego State University in a NOAA Sea Grant-funded laboratory housed at Scripps Institution of Oceanography. He also served two terms on NOAA's Marine Fisheries Advisory Committee, including as the first chair of its aquaculture subcommittee. Hubbs-SeaWorld Research Institute is pursuing federal permits for Pacific Ocean Fresh, a proposed commercial-scale offshore finfish farm in Southern California. The project is undergoing environmental review under NEPA, including preparation of a draft Environmental Impact Statement for public review and comment, and is intended to

advance both sustainable seafood production and the science supporting responsible offshore aquaculture.

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