



HUBBS-SEAWORLD RESEARCH INSTITUTE
ANNUAL REPORT 2015

Greetings

MESSAGE FROM THE PRESIDENT



With your help, this past year has once again been a year of excellence for Hubbs-SeaWorld Research Institute (HSWRI) in accomplishing our mission *"to return to the sea some measure of the benefits derived from it."* Our talented scientists thank you for your financial support that has allowed them to develop innovative research to benefit our oceans, and the precious resources they provide that we all want to continue to enjoy.

During growing concern over climate change, ocean acidification and other environmental challenges, you have stepped up and expanded your generosity toward scientific research and development. Your commitment is filling the

gap left by reduced government funding and has provided leverage for HSWRI to secure partnerships with individuals, corporations and foundations. In addition to helping solve today's challenges, your dedication also directly translates into our scientists' ability to conduct visionary and exploratory research that will positively impact the future's most pressing marine life problems.

Everyone is justifiably concerned about the state of the world's oceans and coasts. The National Oceanic Atmospheric Administration (NOAA) has documented that temperatures measured on land and at sea for more than a century show that Earth's globally averaged surface temperature is experiencing a long-term warming trend. Unusual mortality events (marine animal die-offs), harmful algal blooms, severe droughts and short-term phenomena such as El Niño – these environmental events are negatively impacting marine life and humans around the globe.

What sets HSWRI apart is our determination and commitment to respond to these challenges with a focus on practical and achievable solutions. We won't ever be in the business of sensationalism or advocacy that serves to distract our citizenry from focusing on what really matters – supporting unbiased scientific research, developing and nurturing strong collaborative partnerships, and applying new technologies to resolve these problems rather than leaving them for our children to solve. Our research is designed to help prevent, slow or reverse the negative outcomes that humans and animals face. We don't have all the answers but as our supporter, you can be confident that we are using your charitable investments in the highest way possible toward new advances and solutions. These new discoveries, combined with our decades' worth of comparative long-term research data, are a recipe for success in the mission to conserve our oceans and coasts for future generations.

You can be proud of your support this past year and the positive impacts it promoted, some highlights of which are summarized here. I hope the stories and impacts will inspire you to continue to be our partner in 2016.

I thank you again for working alongside us to conserve and defend the beauty and splendor of our precious oceans and wildlife.

Warmest Regards,

Donald B. Kent
President/CEO

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Front and back cover photos by Michael A. Shane (2015)

*A copy of the official registration and financial information may be obtained from the Florida Division of Consumer Services by calling toll-free 1-800-help-fla (435-7352) within the state. The registration number issued to HSWRI in Florida is CH10200.



Guests enjoying the festivities at a special recognition dinner.



Fascination and conservation education with SeaWorld® animal ambassadors at the annual Donor Picnic.



Honorees enjoy informative dolphin and killer whale interactions at the VIP Donor Appreciation Event.

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This list is comprised of donors who supported Hubbs-SeaWorld Research Institute at \$1,000 and above from July 2014 to June 2015. Though we take every possible step to ensure its accuracy, with a list of this nature it is possible that an oversight has occurred. If your name has been omitted or there is an error in the listing, we apologize and ask that you contact us at 619-226-3871 or solutions@hswri.org.



STEM EDUCATION AND COMMUNITY OUTREACH

In accordance with our public trust mission, Hubbs-SeaWorld Research Institute (HSWRI) seeks to expand the public benefits derived from research through outreach and mentoring and training programs for young scientists. Examples include Seabass in the Classroom (SITC) which provides more than 1,000 students each year with hands-on STEM (science, technology, engineering, math) education in their science classes, and BE WISE (Better Education for Women in Science and Engineering), an overnight workshop that encourages young women to pursue STEM subjects.





Ecological research by HSWRI and colleagues over the past year documented migratory and diving behavior of whale sharks in the Philippines, Indonesia, and the Galapagos Islands. This collaborative whale shark ecology program is the largest of its kind in the world.

Photo credit: Pete Oxford

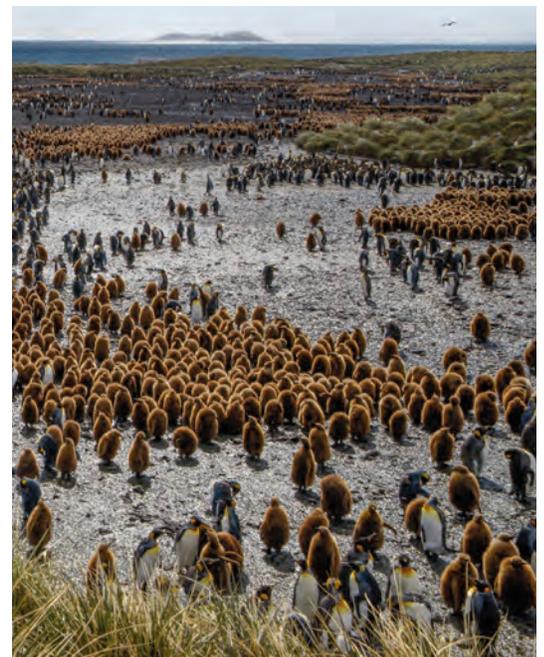
Marine Ecology: Oceans of Life

Ecology is the sub-discipline of biological science that aims to document, understand, and predict the distribution and abundance of life forms. Ecologists consider biological, chemical and physical factors that might explain why an animal occurs in some places and not others, why its population is growing or shrinking, and how a species interacts with the other elements within an ecosystem. Knowledge of these patterns and interactions is the first step in predicting a species' vulnerability to human activities and to environmental changes.

Long-term ecological studies are essential for making sound management decisions for long-lived species like marine mammals, sea turtles, sea birds and large fish. The Hubbs-SeaWorld Research Institute (HSWRI) Marine Vertebrate Ecology Laboratory (MarVEL) has conducted uninterrupted studies of seals and sea lions at the California Channel Islands and of small cetaceans in eastern central Florida since the late 1970s. Field research by HSWRI scientists in these locations in 2015, along with baseline data collected in past decades, supported investigations by HSWRI and others into underlying causes of Unusual Mortality Events affecting bottlenose dolphins in Florida and California sea lions and Guadalupe fur seals on the U.S. west coast.

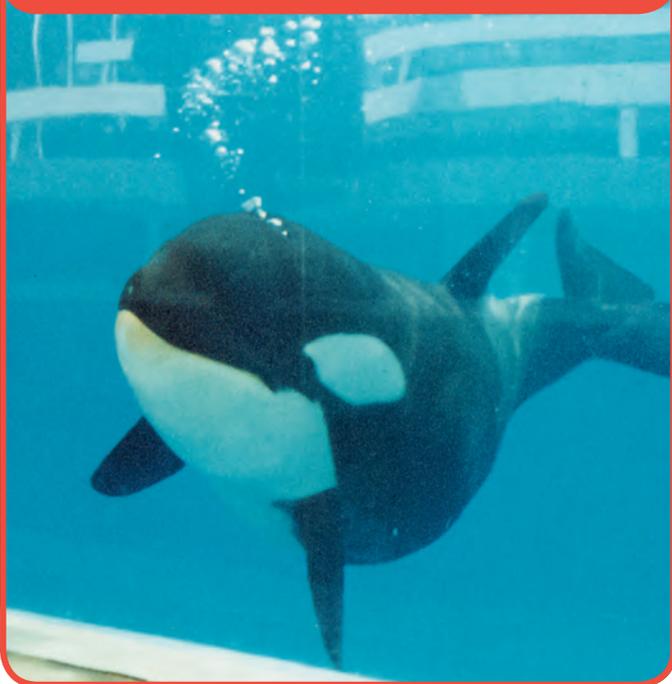


Collaborative photo-identification surveys, combined with data collected from live and dead stranded dolphins, provided new information in 2015 on the movement patterns, habitat requirements, and threats faced by bottlenose dolphins in the Indian River Lagoon, an estuary of national significance, and the previously unstudied adjacent estuarine waters.



HSWRI is taking advantage of emerging opportunities to use unmanned aerial vehicles (UAV), automated remote-sensing instruments, and space technologies to transform the way marine animals are observed in the wild. Aerial photographs (such as this one of a subantarctic penguin colony) allow scientists to evaluate changes in distribution of animals with habitat conditions and over time.

Multi-channel video and eight underwater hydrophones contained in a unique habitat at SeaWorld San Diego allowed researchers to identify which whale was calling and to link certain calls to particular behaviors and social contexts.



Sound & Human Impact on Wild Animal Populations

The Hubbs-SeaWorld Research Institute (HSWRI) Bioacoustics Program promotes marine conservation and sustainable human activity through better understanding of the interplay between animals and their acoustic environment, both on land and in the sea. Simply put, bioacoustics is the study of sound in biological systems, including animal sound production and perception. Sound is especially important in the ocean where light travels poorly. Bioacousticians at HSWRI study the ways in which animals interact with a variety of sound sources, human-made and natural. What they learn has been helping managers, planners, and conservationists protect wildlife for over four decades.

This past year saw the publication of findings from a long-term research program on killer whale communication. Collaboration with zoological parks such as SeaWorld allowed HSWRI scientists to make detailed observations and recordings of individual killer whales interacting at close range and over long periods, something that is not possible in the open ocean. One outcome of this research was finding strong evidence for vocal learning, which has implications for management of wild killer whale pods facing population declines. Other research explored the link between a special class of calls and the production of bubble streams by killer whales in various social contexts.



Patterns of association among some pods of killer whales in the North Pacific have been tracked from boats for decades, but surface-based observers cannot follow complex social interactions that take place underwater or in other obscured conditions. Studies of whales in zoological parks allow researchers to test hypotheses generated by field studies and, conversely, to suggest fruitful avenues of research with wild whales.

Photo Credit: Jessica Crance, NOAA

Health Implications of our Changing Oceans

The health of an ecosystem depends in part on the capacity for acclimation and adaptation of the species that comprise it. Studying how animals react to natural or human-made changes allows us to make predictions about whether animals can survive and/or thrive under a particular set of natural or artificial conditions. HSWRI's Physiology and Ocean Health Program studies the factors that influence the health of marine animals and systems. This includes research into the potential impacts of human activities, climate change, and infectious and non-infectious diseases on population dynamics and on the vitality and performance of individual animals.

Among the threats faced by marine animals are biological toxins produced during harmful algal blooms (aka 'red tides'). This past year HSWRI scientists joined colleagues from several other organizations in publishing a study linking a mass mortality event to a severe bloom of a marine algal species that produces brevetoxin, a potent neurotoxin. The die-off affected dolphins and manatees in 2007 and 2008. The investigators found brevetoxin in a dolphin fetus and a dolphin neonate sampled by HSWRI and in milk from a lactating manatee, providing new evidence that marine mammals may become exposed in utero or while nursing.



Long-term biomedical research at the California Channel Islands continued in 2015, including evaluating seals and sea lions for evidence of exposure to zoonotic diseases (those that can be transmitted from animals to humans) and contaminants.



In 2015, HSWRI scientists conducted examination and isotopic analysis of archived samples collected from stranded dolphins, providing new insights into a 2013 multi-species die-off affecting the plants and animals of the Indian River Lagoon in Florida.

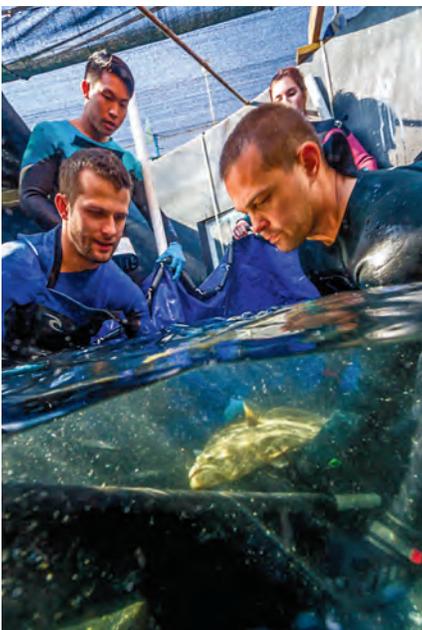


The HSWRI aquaculture team and collaborating geneticists at NOAA Fisheries have identified genetic markers among HSWRI's California yellowtail broodstock that can link yellowtail offspring to their parents. This tool is being used to address questions in spawning dynamics, such as the relative contribution of individual fish throughout a spawning season.

Sustainable Seafood to Feed a Hungry World

Aquaculture is defined as the rearing of plants and animals in water. Breeding aquatic animals from microscopic eggs to market or release size is a complex undertaking requiring multidisciplinary expertise and a sophisticated hatching and rearing infrastructure to control the environment of the fish. For more than 35 years, Hubbs-SeaWorld Research Institute (HSWRI) has conducted basic and applied aquaculture research as a conservation tool to produce food sustainably and to help restock depleted fisheries. This approach illustrates one of HSWRI's strengths – its focus on finding environmentally and economically viable solutions to ever-increasing human demands on sensitive and limited marine resources.

Highlights of the Aquaculture Program over the past year include the recapture of the oldest-to-date (15 year old) white seabass released by HSWRI in collaboration with recreational anglers and the California Department of Fish and Wildlife (CDFW). After two decades of operation and the release of more than 2.3 million tagged fingerlings, the white seabass program began a multi-year external review in 2015. This independent and comprehensive review is being coordinated by California Sea Grant under contract to CDFW, and will help set future direction for the replenishment program. Newly funded or expanded research projects initiated in 2015 include a three year project on egg quality; a two year project on development of self cleaning tanks; a two year project involving gene mapping of California yellowtail; a two year project focused on larval nutrition; and a multi-year expansion of our replenishment research.



This past year saw the launch of a new engineering and education project at HSWRI designed to advance sustainable marine aquaculture in the U.S. by improving larval rearing success and efficiency through self-cleaning tanks with enhanced microbial control.

The success of the white seabass replenishment program has generated public interest in applying HSWRI's expertise to additional marine fish species. Financial contributions from a number of individuals and corporations in 2014 were matched in 2015 by a generous gift from Dorothea Laub, wife of the late Dick Laub.

Creating Your Legacy

You can play a significant role in assuring the success of our mission through planned giving in the form of a bequest or trust.

To discuss your particular interests, please call Eileen Sigler, Development Director, at 619-226-3881.

If you have already included the Institute in your estate plans, please let us know.



Hubbs-SeaWorld Research Institute Financial Information

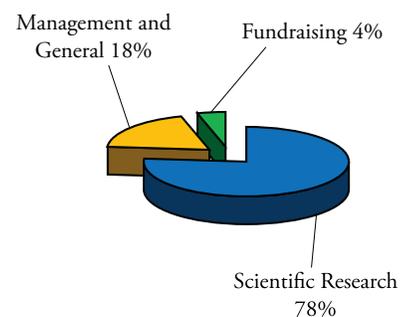
Revenue

Research Contracts and Grants	\$4,150,491
Unrestricted Gifts	\$1,152,141
Restricted Gifts	\$565,688
Other Revenue	\$3,504
Total Support Revenue	\$5,871,824

Expenditures

Scientific Research	\$4,145,223
Management and General	\$1,043,574
Fund Raising	\$239,162
Total Charitable Expenses	\$5,427,959

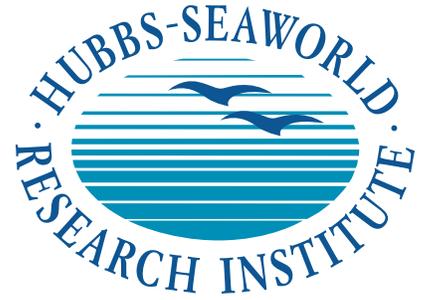
Charitable Expenditure Breakdown by Percentage



A copy of the audited financial statement is available upon request by calling 619-226-3871.

Selected Peer-Reviewed Publications

2014–2015



- Bowles, AE**, Grebner DM, Musser WB, Nash JS, Crance JL. 2015. Disproportionate emission of bubble streams with killer whale biphonic calls: perspectives on production and function. *JASA Express Letters* 137: EL165-170.
- Buentello A, **Jirsa D**, Burrows FT, **Drawbridge M**. 2015. Minimizing fishmeal use in juvenile California yellowtail, *Seriola lalandi*, diets using non-GM soybeans selectively bred for aquafeeds. *Aquaculture* 435:403-411.
- Crance JL, **Bowles AE**, Garver A. 2014. Evidence for vocal learning in juvenile male killer whales, *Orcinus orca*, from an adventitious cross-socializing experiment. *Journal of Experimental Biology* 217:1229-1237.
- Essen DW, Nollens HH, Schmitt TL, Fritz KJ, Simeone CA, **Stewart BS**. 2015. Aphakic phacoemulsification and automated anterior vitrectomy, and postreturn monitoring of a rehabilitated harbor seal (*Phoca vitulina richardsi*) pup. *Journal of Zoo and Wildlife Medicine* 46:647-651.
- Fire SE, Flewelling LJ, **Stolen M**, **Noke Durden W**, de Wit M, Spellman AC, Wang Z. 2015. Brevetoxin-associated mass mortality event of bottlenose dolphins and manatees along the east coast of Florida, USA. *Marine Ecology Progress Series* 526:241-251.
- Gruenthal KM**, Gauger BJ, **Drawbridge MA**. 2014. Maternal reproductive exhaustion in a broadcast spawning marine finfish cultured for conservation. *Aquaculture* 422-423:129-135.
- Hawkyard M, **Stuart K**, Langdon C, **Drawbridge M**. 2015. The enrichment of rotifers (*Brachionus plicatilis*) and *Artemia franciscana* with taurine liposomes and their subsequent effects on the larval development of California yellowtail (*Seriola lalandi*). *Aquaculture Nutrition* DOI: 10.1111/anu.12317.
- Jirsa D**, Davis, DA, Barrows FT, Roy LA, **Drawbridge M**. 2014. Response of white seabass to practical diets with varying levels of protein. *North American Journal of Aquaculture*. 76:24-27.
- Jirsa, D**, Davis, DA, Salze GP, Rhodes, M, and **Drawbridge, M**. 2014. Taurine requirement for juvenile white seabass (*Atractoscion nobilis*) fed soy-based diets. *Aquaculture* 422-423:36-41.
- Kershenbaum A, **Bowles AE**, Freeberg TM, Jin DZ, Lameira AR, Bohn K. 2014. Animal vocal sequences: not the Markov chains we thought they were. *Proceedings of The Royal Society B* 281:20141370.
- Musser WB, **Bowles AE**, Grebner DM, Crance JL. 2014. Differences in acoustic features of vocalizations produced by killer whales cross-socialized with bottlenose dolphins. *Journal of the Acoustical Society of America* 136:1990-2002.
- Rombenso AN, Trushenski JT, **Jirsa D**, **Drawbridge M**. 2015. Successful fish oil sparing in White Seabass feeds using saturated fatty acid-rich soybean oil and 22:6n-3 (DHA) supplementation. *Aquaculture* 448:176-185.
- Rossman S**, Ostrom PH, **Stolen M**, **Barros NB**, Gandhi H, Stricker CA, Wells RS. 2015. Individual specialization in the foraging habits of female bottlenose dolphins living in a tropically diverse and habitat rich estuary. *Oecologia* 178:415-425.

Stewart BS. 2014. Family Odobenidae (walrus). Pp. 102-119 *In*: Wilson, DE, Mittermeier RA, eds. *Handbook of the Mammals of the World*. Vol. 4, Sea Mammals. Lynx Edicions, Barcelona.

Stewart BS. 2014. Family Phocidae (earless seals). Pp. 120-183 *In*: Wilson DE, Mittermeier RA, eds. *Handbook of the Mammals of the World*. Vol. 4, Sea Mammals. Lynx Edicions, Barcelona.

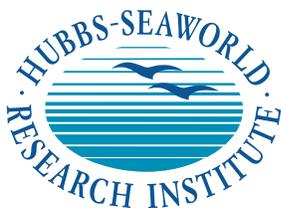
Stewart BS, Grove JS. 2014. An extreme wandering leopard seal, *Hydrurga leptonyx*, at Pitcairn Island, central South Pacific. *Polar Biology* 47:423-425.

Stuart K, Rotman F, Drawbridge M. 2015. Methods of microbial control in marine fish larval rearing: clay-based turbidity and passive larval transfer. *Aquaculture Research* 2015:1-11.

Tosh CA, Nico de Bruyn PJ, Steyn J, Bornemann H, van den Hoff J, **Stewart BS**, Plotz J, Bester MN. 2015. The importance of seasonal sea surface height anomalies for foraging juvenile southern elephant seals. *Marine Biology* 162:2131-2140.

Trushenski JT, Rombenso AN, Page M, **Jirsa D, Drawbridge M.** 2014. Traditional and fermented soybean meals as ingredients in feeds for white seabass and yellowtail jack. *North American Journal of Aquaculture* 76:312-322.

Worthy GAJ, Worthy TAM, **Yochem PK**, Dold C. 2014. Basal metabolism of an adult male killer whale (*Orcinus orca*). *Marine Mammal Science* 30:1229-1237.



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