

Refuge Biology Program Updates May 1-July 31, 2016

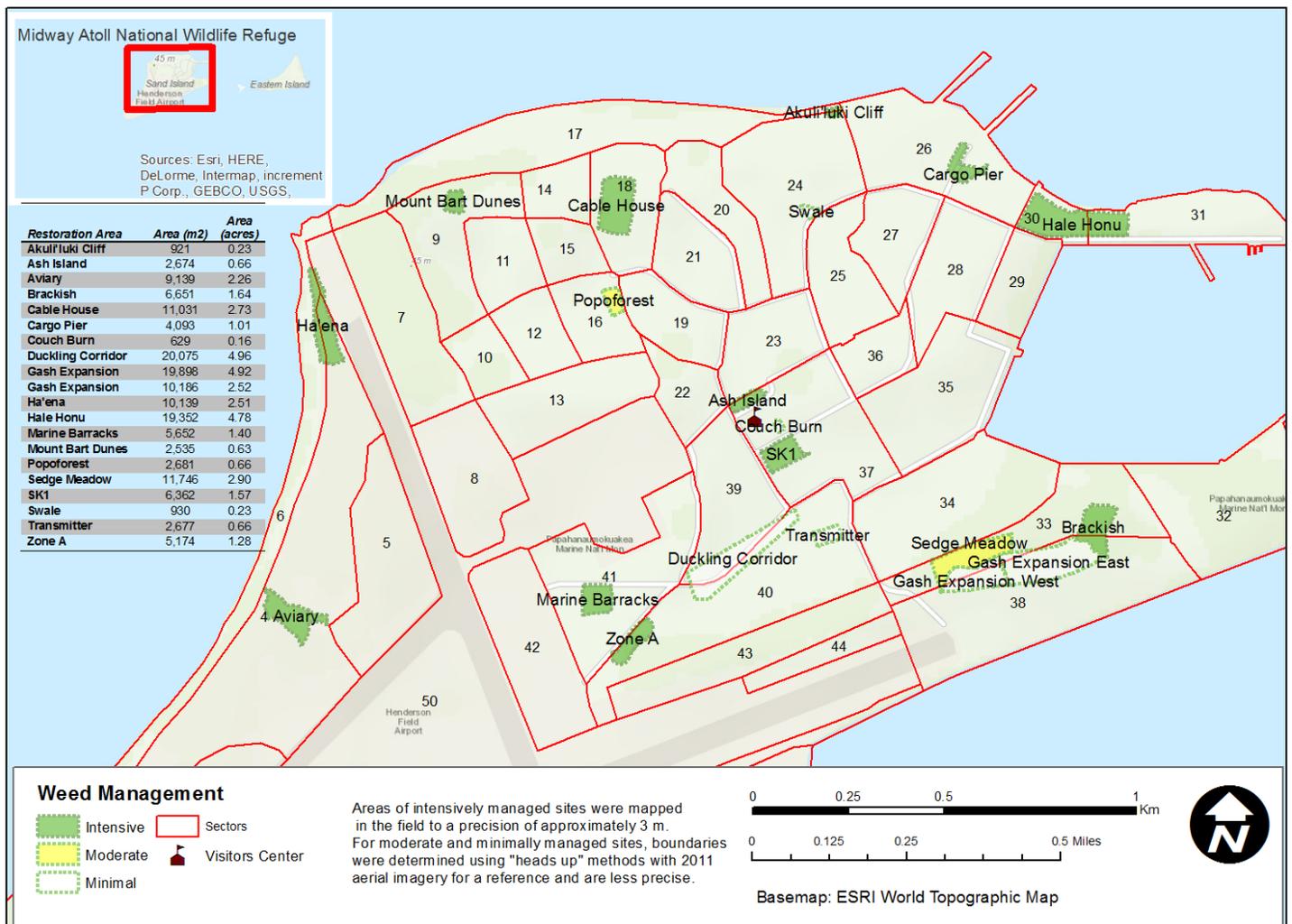
Midway Atoll National Wildlife Refuge

Submitted by: Meg Duhr-Schultz, Wildlife Refuge Specialist

All photos by Meg Duhr-Schultz

Habitat Restoration

Moving into days of more sun, increased chances of rainfall, and fewer albatrosses around, habitat restoration operations have shifted into high gear. We have been very fortunate to have on site Dr. Robert Taylor, a restoration ecologist from Oregon, for the next year serving as our Restoration Data Management Specialist. Rob is a temporary employee of the National Wildlife Refuge Association (NWRA) and his position was made possible by the FWS Pacific Region Inventory and Monitoring Program, the NWRA, and the Pacific Islands Refuges and Monuments Office. Rob has spent his first several months on Midway working to restore functionality to our GIS and add current layers, such as the restoration site map below, and help us use geospatial and other database technology to manage expanding weed control, native plant nursery, seed collection, and out-planting operations. Now that *Verbesina* is no longer the dominant invasive plant on Midway (though it remains a *high threat*), conditions on the ground are changing rapidly and native plant restoration is, for many areas, one of the best tools for on-going invasive plant control, rather continued herbicide applications. Rob is helping us create user-friendly systems for managing our native plant inventories and tracking success rates from seed to out-plant site, as well as monitoring weed control activities Refuge-wide, so that staff can strategically direct weed control efforts over an increasingly complex landscape. The overall goal of this project is create integrated restoration data management systems that will not only be useful and user-friendly for Midway staff, but can be adapted for use on other Pacific Islands habitat restoration projects.



Map of current native plant restoration sites on Sand Island with site acreages (Rob Taylor, 2016)

Native Plant Nursery Operations

Current native plant nursery facilities include the original hard-sided greenhouse, an outdoor plant hardening area (established in 2015), and a new soft-sided 6,600 square foot shadehouse, recently donated by the Friends of Midway Atoll. The new shadehouse has increased the potential of our native plant nursery operation nearly tenfold and we have been gradually increasing its operational capacity since it was erected this winter. Thanks to the efforts of our on-island contractor, Defense Base Services Inc. (DBSI), habitat technicians and FWS staff and volunteers this summer, the shadehouse is now operating at 50% capacity, with 50 10' x 3' tables for raising native plants. We have also done trial runs with various irrigation approaches and are developing plans for table and irrigation systems for the second half of the shadehouse.

FWS Volunteer Propagation Specialist Naira de Gracia has been working with FWS staff since March as we scale up operations to monitor propagation results and develop protocols for propagation, seed collection, and greenhouse management that are relevant and useful to Midway staff. Thanks to her efforts and experiments with watering schedules, fertilizer applications, propagule type, and potting medium, we have had substantially better greenhouse and field results with 12 species that are priority plants for restoration projects at Midway.



Naira de Gracia (at right) leads DBSI habitat techs Sak, Ek, and E in propagating beach morning glory (*Ipomoea pes-capre*) in the greenhouse.

Table 1. Native plant nursery production May-July 2016 (units are in pots made)

	Boerhavia repens	Solanum nelsonii	Sporobolus virginicus	Ipomea pes-capre	Lepturus repens	Sida fallax	Fimbristylis cymosa	Eragrostis paupera	Chenopodium oahuensis	Tournefortia argentea	Eragrostis variabilis	Scaevola taccada	Total pots per month
May	183	66	119	169	46	76	48	28	99	0	560	0	1394
June	0	14	231	158	0	16	48	17	95	136	230	81	1026
July	116	317	218	187	34	0	0	0	0	0	520	81	1473
Totals	299	397	568	514	80	92	96	45	194	136	1310	162	3893

*not included on this table are small scale propagation efforts for species which are extremely rare on Midway, such as *Waltheria indica* (25 pots) and *Lepidium bidentatum* (24 pots)



FWS volunteers Naira de Gracia (left) and Aisha Rickli-Rhaman (right) lead other volunteers in up-potting Popolo (*Solanum nelsonii*) seedlings into larger pots for continued greenhouse care. Ramping up our propagation efforts for this rare species has been a multi-year project. Starting with a population of 4 individuals on both Sand and Eastern Island, propagule collection was limited to seeds because of the need to minimize impacts to our source plants. Efforts in 2015 focused on raising batches of plants from these seeds and out-planting them into areas where they could intensively managed and cared for.

This strategy was successful and we currently have an established Popolo population on Sand Island that is robust enough to serve as our source of plant material to support large-scale propagation from cuttings. Growing this species from seed is not a preferred method because of how time and labor intensive it is.

The volunteers at left are transferring one of our last batches of Popolo seedlings into larger pots. Popolo is now one of our most common plant species that is planted at restoration sites.

Native plant seed collection

Though opportunistic seed collection happens year-round at Midway, late spring and early summer is the busiest time for collection of native seeds. Housed in a climate controlled, unused office at the FWS Headquarters, the seed library was established in 2015 and has continued to expand its scope this summer. Native seed collection is critical to habitat restoration at Midway because of its long history of non-native species introductions, extensive paving and island hardening, and island expansion. Due to all of these disturbances and the artificial environments we work with, the native seed bank is minimal or non-existent. Unlike in other restoration projects, removing invasive weeds will not “release the native seed bank” because Midway, to large extent, does not have one.

Native seeds are collected in the field from areas where there is an abundant source and recruitment potential is low, for example a patch of mature *Chenopodium oahuensis* growing a sea of invasive Bermuda grass. Seeds are then processed and stored according to species-specific methods and then used in restoration areas. In 2015 and 2016, we have begun to see native plant growth from seed in the field in many restoration sites. This method of native plant restoration is not suitable for Refuge acreage outside of the restoration sites because of competition with the faster growing invasive plant species.

Primary seed collection targets between May and July this year were beach morning glory, bunchgrass, *Chenopodium*, and two native sedge species: button sedge and *Cyperus polystacheos*. All of these seeds will be used in upcoming restoration projects this fall.

Table 2. Seed collection efforts May-July 2016 (units are in grams of pure seed)

	Boerhavia repens	Chenopodium oahuensis	Eragrostis paupera	Solanum nelsonii	Ipomea pes-capre	Cyperus polystacheos	Eragrostis variabilis	Fimbristilis cymosa	Waltheria indica	Lepturus repens	TOTAL grams per month
May	0	221.04	0	37.76	0	0	1378.72	0	0.11	0.12	1637.75
June	3.78	1713.12	0	31.8	0	696.17	867.09	378.65	0.8	0	3691.41
July	8.34	758.58	0.65	115.44	1453.13	1300	1,000	0	2.4	0	4638.54
Total grams harvested	12.12	2692.74	0.65	185	1453.13	1996.17	3245.81	378.65	3.31	0.12	9967.7

Native plant out-planting operations

In June the albatross chicks began to fledge and the island became a little safer for new native plants to get established in the field. Late stage chicks have prolonged periods of waiting around their next for their next feeding from their parent and any vegetation in their vicinity gets shredded during their long, hot, and boring days. June and July were therefor very busy as the Biology staff and volunteers raced to out-plant hundreds of plants from the nursery facilities into restoration sites. Even with dramatically lowered bird density, all native plants must have a protective fence installed around them. For many species, this fence must be in place (and checked for entrapments and regularly maintained) for up a year. Because native Hawaiian plants are so slow-growing in Midway’s deeply modified soils and the pressure of millions of seabirds is relentless, native plants must be very robust to survive the root disturbance from Bonin petrels and foliage destruction from albatrosses. We are transitioning into a new plant tracking system, so data is presently unavailable for May and June outplantings.

Table 3. Native out-plantings at restoration sites (month of July ONLY—data not available for May and June)

Restoration Site	Sesuvium portulacastrum	Solanum nelsonii	Sporobolus virginicus	Ipomea pes-capre	Sida fallax	Fimbristilis cymosa	Pseudonaphthium sandwichensium	Chenopodium oahuensis	Tournefortia argentea	Eragrostis variabilis	Lepidium bidentatum	Total pots per site
Mount Bart Dune		8			20	15	18	10	3		6	80
Ash Island			30								2	30
Akuli`kuli Cliff		8			12			10				30
Aivary		86	97	30	28				8			249
Hale Honu	50	19	30		58				11	180		348
Ha`ena	29											29
											TOTAL	766



Biology Volunteers Yuki Takahashi, Naira de Gracia, and Savannah Smith collect Akuli`kuli (*Sesuvium portulacastrum*) from the outer tip of “Bulky Dump,” a Navy landfill that projects 350 meters into the sea from the south side of Sand Island. Relatively rare at Midway, this plant was only found in three spots on Sand Island prior to 2015. Establishing additional patches of this native Hawaiian coastal plant is a priority for the program and we have focused on transplanting large batches of well-rooted plant material into beach crest areas of restoration sites on Sand Island. The outer tip of Bulky Dump is an ideal collection site, because major repairs to the containment seawall and cap are planned in the coming years and all plants on the Bulky Dump peninsula could be lost during heavy equipment operations.

During the month of June, Refuge Biology volunteers transplanted 79 clusters (each containing 10-15 individual plants) into restoration sites.

Table 4. Overview of restoration site maintenance activities May 9-July 29

Site Name	Outplant Watering	Other Maintenance (fencing, etc.)	Invasive Plant Control	Total person hours
Akuli'kuli Cliff	7.5	6	3	16.5
Ash Island	3	2	2.5	7.5
Brackish	2	3	58	63
Cable House			28.5	28.5
Gash		1	76.5	77.5
Ha'ena		18	5	23
Hale Honu		40	62.5	102.5
Other outplant sites	9	14		23
Popoforest		8	14	22
SK1		1	6.5	7.5
Aviary	20	40	21	81
Spit Island			12	12
Marine Barracks			10	10
Mt. Bart Dune	16	10	6	32
Grand Total	57.5	143	305.5	506



Biology volunteers work with DBSI habitat techs to install protective fencing around recent *Sesuvium* transplants at the Akuli'kuli Cliff restoration site.

Restoration Site Highlights



A scene from one of our most recently established restoration sites, Ash Island. Though it is less than an acre in size, this site is packed with dense and robust native plants, nearly all of which came from direct seeding efforts. Ten months ago, this site was a closed-canopy ironwood forest, with invasive grasses dominating the ground layer. Following tree removal to protect the FWS Office right across the road, the piles of dead ironwoods were burned in place. We placed several native seed mixes in the interior of the site, and out-planted bunchgrass and *Tournefortia* around the margins, to provide some immediate shade and burrowing habitat while plants from seed became established, as well provide a barrier to windblown or vehicle-based importation of invasive plant seeds.

This site is dominated by native plants: `Ilima (*Sida fallax*), Alena, Popolo, bunchgrass, and *Chenopodium*. Direct seeding onto former ironwood burn sites has proven to be a highly successful method for rapidly establishing dense native plant cover from seed, because the heat seems to destroy the seed bank of invasive plants and the ash layer provides rich nutrients for desirable natives. Though this method is not often available to us at Midway due to conflicts with seabirds, when we can burn ironwoods, the positive results come rapidly.



With the exception of the ironwoods in the background, all plants in this frame from the Brackish Pond restoration area are native Hawaiian species.

Two years ago, this site was dominated by a forest of standing dead ironwood trees with invasive grasses and aggressive, ground covering forbs which outcompeted all remnant native plants. Intensive restoration efforts began at this 2-acre site in September 2014, with removal of the ironwoods and burning of the piles in place. Follow-on direct seeding of native species in the burn piles, coupled with out-plantings were highly successful. As one of our most established restoration sites, there is zero tolerance for invasive weeds here; and in this setting, natural native plant recruitment is actually taking place.

The high investment in this site appears to be paying off as intervals between weed control sessions are increasing and the time required to control all weeds in the site is decreasing. Sites like Brackish Pond provide hope that native plant communities can actually become self-sustaining on Sand Island, once sufficient density is achieved.



Thriving native plants now dominate the Cable House restoration site. A challenging site due to previous building removal projects and lead contaminated soil remediation, the mass importation of salt-laden, mostly sterile beach sand, presented many difficulties for native plant establishment and a large blank expanse for invasive weeds to recruit into. Native plant restoration efforts have been in place here since 2013 and intensive weed control has been underway throughout.

In spring 2016 we began to finally shift the site to a stabilizing native plant area. Native button sedge, alena (*Boerhavia repens*), Naupaka, bunchgrass, aki aki grass (*Sporobolus virginicus*), and `Ena`ena (*Pseudonapthalum sanwichiense*) began to spread by seed on their own across the site and our weed control intervals became substantially wider. Future out-planting needs are minimal at this site because of the existing level of recruitment and our recent weed control efforts here have focused on eliminating rapidly spreading, high seed-producing annual forbs such as alyssum and several *Euphorbia* species, because these species are known to prevent native seedling recruitment.

Verbesina Eradication

- Between May and July, Refuge Biology volunteers and staff contributed 179 hours assisting with Refuge-wide invasive plant control efforts. The primary target during this time was *Verbesina enceliodes*, a species which has seen drastic decreases in cover due to previous successful USFWS control efforts. Turning the corner from aggressive control to full eradication will take significant additional effort, however. As with many eradication projects, eliminating the final 1% requires a complete re-tooling of efforts. While the plant is sparse, it remains widespread across the Refuge, and is particularly common in difficult to access and low visibility areas such as dense naupaka thickets.

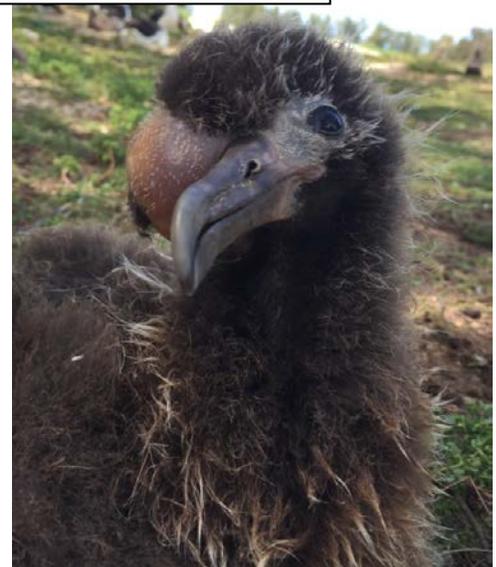
FWS volunteers have been a great support to the contracted DBSI Verbesina control technicians during this year's *Verbesina* season and have assisted with field data collection on several monitoring projects, including herbicide efficacy trials on Eastern Island and a germination monitoring study on Sand Island. Current data on kill rates with our current herbicide mix, as well as time from germination to seed production were needed to inform management efforts as the project moves into its final phase.

Emerging issues in wildlife and native plant health

- A number of droop-winged Laysan albatross chicks were observed this year in areas where lead contaminated soil remediation occurred as recently as fall 2015. A small-scale temporary banding and daily monitoring program was initiated to track the fate of a sample of birds from the impacted areas and recover any carcasses as quickly as possible. 8 dead chicks were recovered, frozen, and shipped to the Honolulu Field Station of the USGS National Wildlife Health Center to determine cause of death and whether on-going lead exposure was a factor. We anticipate hearing necropsy results later this summer.
- This spring Refuge staff observed an above average incidence and areal extent of avian pox (*Poxvirus avium*) cases among Laysan albatross chicks on Sand Island. Avian pox is a virus transmitted by the invasive mosquito, *Culex quinquefasciatus*, which is abundant on Sand Island. Typically thought to be non-lethal, many birds were observed this season with pox lesions severe enough to cause permanent disfigurement and eventual death on island before fledging. Considering significantly below average rainfall during winter 2015-2016, the prevalence of this mosquito-borne illness was not anticipated and is a possible cause for concern, given future climate change scenarios which predict similar rainfall scenarios for the NW Islands in winter. Staffing resources did not permit monitoring of the situation this year.

Left: In Ballfield Pond every chick in the foreground is infected with avian pox.

Right: A chick with a severe pox lesion, which destroyed its right eye. The chick was found dead the next day after the photo was taken.



- Invasive ants (tentatively identified as black crazy ants) and scale insects (a.k.a. mealy bugs) have infested many of the out-planted Popolo (*Solanum nelsonii*) in restoration sites on Sand Island. Though the ants have probably been on Midway for some time, the increase in the Popolo population is a recent development. A candidate species for ESA listing, increasing the local population of this species has been a high priority for the native plant program. Starting with a population of 4 mature individuals in 2013, we have increased the population to over 150 mature plants through intensive propagation and outplanting efforts. The emerging threat from ants and scale insects has killed 5 large, established plants in less than four weeks. We are unsure why some plants survive an ant infestation and others perish, though we consider the entire Refuge population at risk. We are presently are looking into options for controlling scale and protecting the remaining population.



Ants believed to be black crazy ants “farming” their mealy bugs on a Popolo plant grown from seed and out-planted by FWS volunteers.

Laysan duck management



Duckling season is in full swing and although intensive brood monitoring cannot be carried out at current staffing levels, it appears to be a successful breeding season, with multiple broods observed at all locations with freshwater on the Refuge. Pictured at left are three separate broods displaying the range of age classes in one of the constructed ponds on Eastern Island. Behind the ducks are lush beds of native Makaloa sedge (*Cyperus laevigatus*), a species important to ducks for forage, cover, and improved water quality.

2016 botulism season update

While the number of probable avian botulism type C cases in adult ducks has remained quite low so far this summer, the timing of sick duck encounters means that staffing resources required for sick/dead duck detection patrols mirrors that of higher risk periods. At this time, intensive patrols remain one of the only tools available to the Refuge to prevent large-scale epizootic outbreaks of the disease, and thus threaten the viability of this small, but intensively managed

Midway population. The crew has been conducting daily patrols of all artificial ponds and guzzlers to locate sick or dead ducks since June 18th-present.



Honolulu-based FWS Biotechnician Katrina Scheiner administers subcutaneous fluids to a botulism-sickened duck, while FWS Volunteer Savannah Smith assists. Intensive fluid and nutritional support over the days following administration of the botulism anti-toxin have dramatically improved rehabilitation outcomes for this species. In periods of limited staffing, volunteers (once trained) play a vital role in continuing the botulism rehabilitation program.

Table 3. Suspected botulism cases in adult Laysan ducks, May-July, 2016

Month	# dead, suspect botulism	# sick	# died in captive care	# successfully rehabilitated and released	Monthly total suspected botulism cases
May	2	2	2	0	4
June	0	2	0	2	2
July	2	3	1	2	5

Ironwood removal

In the coming weeks, DBSI contractors will begin the first of several large-scale ironwood removal projects over the next few years. Though this invasive tree seriously degrades habitat quality for most species of native seabirds and prevents plant growth in its understory due to allelopathic properties, the primary reason for removing trees in the 2016 project area is safety and regulatory compliance. Approximately 7.5 acres of ironwoods will be removed from the Southeast section of Sand Island because they have the potential to interfere with the visual approach of pilots landing on the east end of Henderson Field. In order for the Henderson Field ETOPS airport to comply with current FAA regulations, the trees must be removed.

Removal of thousands of trees from a remote island poses myriad challenges, but at Midway, bird avoidance and harm minimization is perhaps the largest. Project timing helps avoid impacts to winter nesting seabirds, but white terns, which nest year-round with summertime breeding peaks, commonly nest in ironwood trees. Efforts to minimize our impacts to white terns began in January, with herbicide treatment of all trees in the project to increase nest detection ability, and resumed in July, when biology staff and volunteers began regular patrols of the project area to remove white tern eggs and survey for nests of other seabird species. Egg removal is considered the most humane method to reduce impacts to white terns because of the high potential for chicks and adult to be injured during tree felling. Chicks in the project area who survive tree felling without serious injury are taken to a captive rearing area, where they are monitored and hand-fed small fish until they fledge.

In July, ironwoods were also removed around buildings and residences on Sand Island to support on-going lead contaminated soil removal. A similar approach with chemical treatment long before tree removal, coupled with white tern egg removal and other seabird surveys was applied for this project. As of July 31, we have 19 white tern chicks in the captive rearing area. All current activities are permitted under USFWS Migratory Bird Special Purpose Permit #MB64615B-0.

A downy manu-o-kū white tern chick with herbicide treated trees in the background in the FAA tree removal area.



Honolulu-based FWS biotech Allie Hunter feeds a white tern in the captive rearing area. Each chick in the captive rearing program is offered fish three times per day and regular vitamin supplements.

Other volunteer activities

Boating operations



On temporary loan from the Honolulu office, FWS staff and volunteers (left to right) Katrina Scheiner, Keely Hassett, and Allie Hunter got some helm time with Meg after recently becoming certified operators. The team practiced operating all three small boats, docking, maneuvering in close quarters and shallow reefs, beach landings, and anchoring.

Education and Outreach

FWS volunteers broke the bolus collection record set in the 2015 by collecting over 1300 albatross boluses to support the bolus distribution program led by Ann Bell and Amy Oliffe of the Honolulu FWS Office. It is worth mentioning that a majority of the collection efforts took place as *volunteer*-volunteer efforts, meaning that FWS volunteers who had already worked a minimum of 40 hours/week performing their core duties assisting with habitat and wildlife management, spent many additional hours in field collecting boluses on their evenings and weekends. The current group of volunteers, deeply moved by the feedback from educators around the country who received boluses and shared stories of environmental change the bolus encounters inspired, truly went above and beyond this season.