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Point Reyes Bird Observatory to Point Blue Conservation Science: the Origins, Evolution, and Future Directions of an Innovative, Non-Profit, Science Organization

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ABSTRACT—A bird observatory is a research and education institution whose overall and primary mission is typically to provide information on the life history and conservation of birds. Originally known as the Point Reyes Bird Observatory (PRBO), this institution has survived and flourished since its founding more than 50 years ago. Known in later years as Point Blue Conservation Science, it has been led and staffed by a camaraderie of dedicated and inspired people. It has also provided important leadership in field ornithology and related fields of natural history, and most importantly, as a leader in conservation science. We summarize here some of its accomplishments and pay tribute to many of the talented people whose inspiration and vision have contributed so much to our knowledge of birds from California, the west, and, indeed, from throughout the world.

ORIGINS AND EVOLUTION

Founded in 1965 in coastal California as a bird-banding station, Point Blue Conservation Science (Point Blue) is the home of one of the original three long-term bird monitoring stations operating in North America (after Bird Studies Canada's Long Point Bird Observatory in Southern Ontario and Carnegie Museum of Natural History's Powdermill Avian Research Center in Southwestern Pennsylvania, both founded a year or two earlier). The founding of these organizations, all focused on birds, followed closely behind Rachel Carson's 1962 publication of *Silent Spring* and the public awareness of how birds can serve as biological indicators of toxins in the environment and human health.

Birds are loved and well-studied and, with careful observation, can inform us about the natural world and how to conserve it. Their beauty and diversity and the unpredictable occurrence of some species on the

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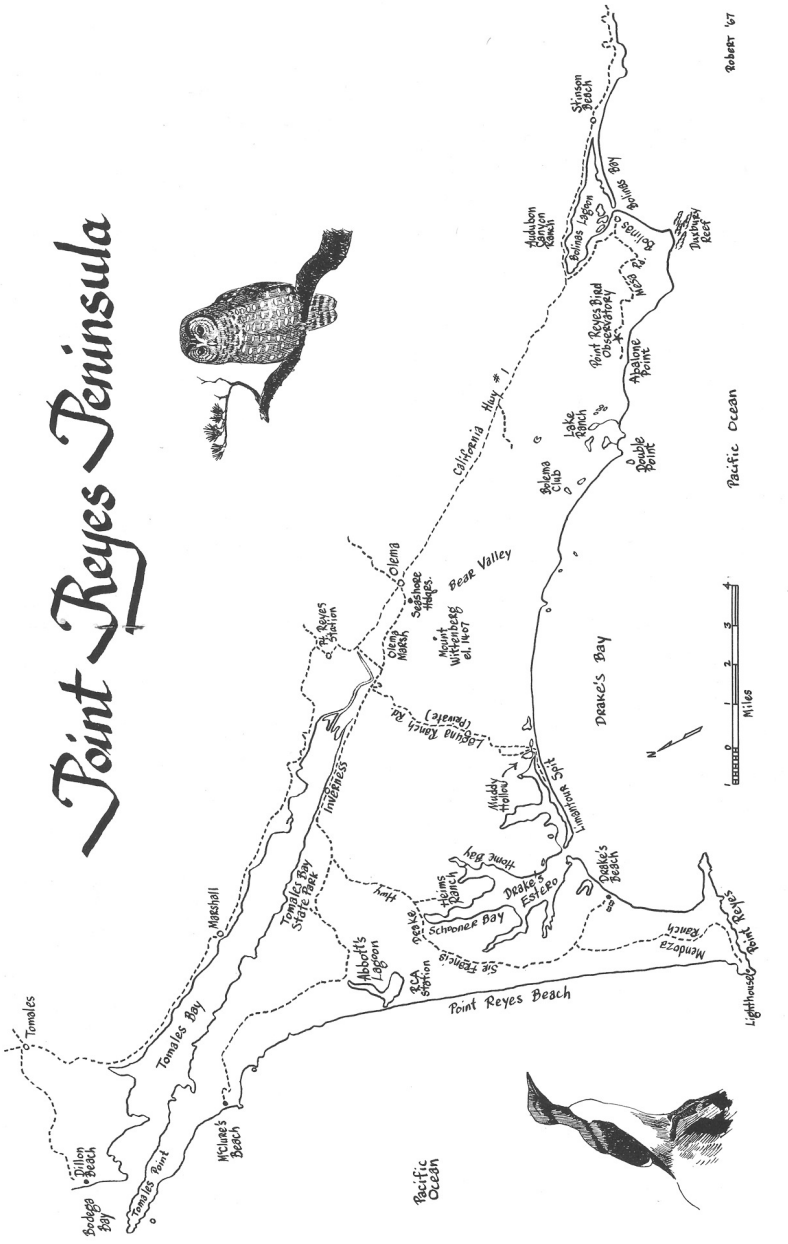

Figure 1. Map of the Point Reyes Peninsula with locations mentioned in the text. The Farallon Islands are located just off the bottom of the map. Courtesy of PRBO.

Point Reyes Peninsula (Figure 1) in coastal Marin County, California, incubated the idea to a dedicated few to start a scientific organization to understand bird movement, but quickly expanded to how, when, and where birds can thrive. As described below, the original four programs focused on landbirds, waterbirds, seabirds, and the common thread between them—education and outreach (training, newsletters, field trips and groups visiting the field station). As the importance of where birds lived (their habitat) and their facility as indicators of healthy ecosystems grew, the organization's scope expanded greatly to include functioning ecosystems with the science on birds being the underlying foundation of understanding how to apply conservation. We welcome the opportunity provided by this article to celebrate the path that has allowed proliferation of Point Blue's research programs, accomplishments, and global influence.

The gradual evolution of the sobriquets of the observatory, from its beginnings as the "Point Reyes Bird Observatory," followed by "PRBO Conservation Science" in 1992, and most recently in 2013 to "Point Blue Conservation Science" (Point Blue). The name changes reflect the evolution of the mission of the organization from understanding birds' movements through scientific studies to the present-day statement that "Point Blue advances conservation of birds, other wildlife and ecosystems through science, partnership and outreach." While its core strength remains in birds and their conservation issues, Point Blue has expanded its mission to include all wildlife and, perhaps more importantly, the human dimension of conservation. The current highest priority "is to reduce the impacts of habitat loss, climate change and other environmental threats while promoting nature-based solutions for wildlife and people on land and at sea." The name "Point Blue Conservation Science" not only gives a nod to our past ('Point Reyes') and leadership direction in the future ('Point'), it describes the organization's main activity ('Conservation Science') and what a healthy planet earth looks like from space ('Blue'). Throughout this essay, we will use the term "PRBO" to capture most of the historic aspects of the Programs, and "Point Blue" to capture new and emerging missions and ideas.

Role of Bird Observatories and NGOs in bird research and monitoring.—The bird-oriented, non-government organizations (NGOs), mostly known as bird observatories, such as Point Blue, have

been monitoring bird populations in North America for decades. These mostly regional organizations have strong grass roots and private sector support and thus are able to conduct truly long-term studies by using non-traditional funding and staffing with dedicated volunteers, interns, and staff. These organizations can provide the expertise needed to implement and maintain long-term monitoring programs that are required to separate anthropogenic from natural fluctuations in populations as well as the insight into their causes (Geupel and Nur 1993). Many organizations originally known as bird observatories are changing their names to reflect expanding missions, geographies and/or to help raise funds from non-traditional sources.

While the public often assumes incorrectly that federal and state governments and agencies are responsible for most natural resource monitoring, the vast majority of bird monitoring in North America is conducted by NGOs. These NGOs bring to the table their partnership networks, including private individuals, local and national organizations (such as Cornell University's Laboratory of Ornithology, The Institute for Bird Populations, local Audubon Societies, and bird clubs). They also collaborate with key partner agencies (e.g., The National Park Service, USDA Forest Service, U.S. Fish and Wildlife Service, Department of Defense, Bureau of Land Management, and various state wildlife agencies), along with a dynamic continental network of bird conservation initiatives such as North American Bird Conservation Initiative, (NABCI) Partners in Flight (PIF) and The U.S. Shorebird Conservation Partnership. These initiatives and their hundreds of partners generate millions of biological observations each year from the operation of over a 1,000 bird monitoring stations. Often funded by agencies, they are most often leveraged with funds from private sources (most often individuals and foundations).

Overall, these NGOs can provide large long-term data sets that form the basis for important conservation-oriented research on life histories, population trends, and the causes of changes (Wiens 2008). These data are used by researchers, consultants, agricultural producers, land trusts, agencies, and others extensively for adaptive management, conservation and stewardship planning, reports, manuscripts, dissertations, theses, and fundamental advances that can only be driven by good, solid, and quantitative science.

In its founding year, PRBO received its first grant from the members of the Western Bird Banding Association for a few hundred dollars, funding a part-time biologist stationed within the Point Reyes National Seashore. In stark contrast, in 2017, the annual budget for Point Blue is $14 million, supporting 212 staff, including 161 scientists working from the Sierra Nevada Mountains to the sea and from Alaska to Antarctica. Approximate 50% of the $14 million is provided by the private sector (individuals and foundations) and is integral part of projects being 'value added' to government sources.

Origins with Western Bird Banding Association.—We are often asked about who the founders of PRBO were. As with any determination of a progenitor, it is not the first two or three people who set the ship on its course in the first couple of years, thus enabling its future, but it is, at the least, the first 20–30 people, during first 5 or 10 years, that got things underway.

We were fortunate: we were at the right time (it was the 60s, anything was possible!), the right place (beautiful west Marin), the right birds (incredible diversity of habitat on the peninsula and the out of range birds known as "vagrants"), and the right people (scientists, biologists, birders, banders, all largely volunteer-based).

Success has many fathers … only failure is an orphan. The ideas and the people that made them possible have been documented (LeValley unpublished, Stallcup 1985, and Paxton 2015) and those accounts differ in relatively minor degrees from each other. Truth be told, the real impetus was the rare birds, the vagrants, of the Point Reyes Peninsula and the Farallon Islands. These rare birds thrilled various folks birding on the outer peninsula in the late 1950s, with the Farallones on the horizon, about 25 miles away. Ralph pored over accounts at the Life Sciences Library on the Berkeley campus, where he made the first list of species of the island (Ralph 1968). All the birders of the day dreamed and talked on and on about vagrants and migrants during birding trips, especially fueled by Rich Stallcup, Guy McCaskie, and many others.

As a little background, members of the Western Bird Banding Association had "some years of informal discussion in the late 1950s and early 1960s on the need for an observatory in the European tradition" (L. R. Mewaldt, *in litt.*). "After an initial attempt about 1960 at Año Nuevo Point in San Mateo County, … our break came in 1964

when C. John Ralph … was a Seasonal Ranger at the Point Reyes National Seashore." In that spring Ralph was a graduate student of Mewaldt at San Jose State University and was hired for a couple of semesters to clean sparrow cages. After a few months, as Ralph was perhaps not a great cage cleaner, Mewaldt suggested he find other employment. Thus, he became the first seasonal ranger at the newly-established Seashore. Over this summer, he roamed the peninsula showing the Park Service flag, birded, put together a checklist of the birds of the National Seashore (published later as Lenna and Ralph (1968), and checked the tree islands for landbird vagrants on the outer peninsula. Ralph brought up the idea of a bird observatory to the National Seashore Superintendent Fred Binnewies who was very enthusiastic.

Ralph wrote invitations to a meeting on 27 October 1964 to several members of the Western Bird Banding Association. Then, as LeValley (unpublished) notes: "On Sunday, November 1, 1964 a committee appointed by Bruce Swinehart [a professor at Sacramento State College], President of the Northern Chapter of the Western Bird Banders Association, met at the home of L. Richard Mewaldt to discuss the feasibility of establishing a permanent bird banding station. At the meeting were Enid Austin, Howard Cogswell, Lilian Henningsen, William Kirsher, Richard Mewaldt, Eleanor Radke, C. John Ralph and Robert Paxton." According to notes of the meeting taken by Lillian Henningsen, the members endorsed the idea, thus PRBO was born and a board established. We found in minutes of the meeting a note that Swinehart and Rich Stallcup were unable to attend. At the next meeting, on 17 January 1965, at the Museum of Vertebrate Zoology (MVZ), some of the above PRBO Board (Austin, Cogswell, Henningsen, Kirsher, Mewaldt, Radke, Ralph, and Paxton), and new Board members, Emerson Stoner, Junea Kelly, Michael Evans, and Dorothy Hunt, met and approved a budget of $500 per month. Also present at this meeting was Paul DeBenedictis (soon to become the first biologist) and MVZ ornithologist, Ned K. Johnson. Mewaldt became the first President of the Board, and, in many functions, the first Director of the observatory.

Finances, budget growth, and the relative role of donations/grants/contracts.—Negotiation with the Park Service resulted in a building being assigned to the observatory on what was

called the Heims Ranch (Figure 2). This was rumored to be a former chicken house amongst pastures near the shores of Drake's Estero in the center of the peninsula. Howard Cogswell took the lead and initiated a migration banding station (called "Operation Transient") in the riparian vegetation along a nearby creek, employing the first biologist Paul DeBenedictis, and later Rich Stallcup through the fall (Cogswell 1966). The financial contribution of a few WBBA members, including Lillian Henningsen and Enid Austin, who wrote checks of about a hundred dollars each (about $800 in 2018 dollars), was key in the initial months.

After a year (September 1965), the newly-hired biologist Ted Van Velzen (formerly of the U.S. Bird Banding Lab in Laurel, Maryland), and Marianne Shepard of Glen Ellen, California, an avid bander and birder, were in contact with Seashore officials, resulting in the observatory being offered a long-term lease on a new home on the south end of the National Seashore near Bolinas. The building was the former

Figure 2. The first home of PRBO in 1965 on the Heims Ranch, in a rumored converted chicken house. Photo courtesy of PRBO.

school house of a religious community called the Church of the Golden Rule who in 1963 sold their ranch lands and settlement, known as the Palomarin Ranch, to the General Service Administration to be included in the newly formed Point Reyes National Seashore. The several buildings and residences of the main part of the community were demolished over the next couple of years. The school house became the headquarters and field station of the observatory on 23 June 1966. This operation continues today, as the Palomarin Field Station. There have been two major remodeling projects funded by The National Science Foundation facilities grants along with matching funds from private donors. The station continues to operate a constant effort mist-netting station, conducts breeding studies using spot mapping and nest monitoring, as well as maintaining a world-renowned intern program. The site is located on an ancient sea terrace, called The Mesa with, at the time of the founding, a spectacular view across grassy fields formerly cultivated for crops and flowers by the church to the cliffs overlooking the ocean about a quarter mile away. Due to lack of disturbance the former fields have changed from open fields to coastal scrub, and now to coniferous forest. These long-term changes in the vegetation community and corresponding change in the bird community have been thoroughly described by Chase et al. (2005) and Porzig et al. (2014).

Significantly, the Farallon Islands were beckoning on the horizon about 25 miles away. The new station was located on essentially the closest mainland site to the islands, and they were soon to play an important role in the future of the observatory. Also nearby, was Bolinas Lagoon, host to myriad water and shorebirds. Doris Leonard, a long-time Board member and supporter, chronicled the real estate travails of PRBO in her article (Leonard 1975). In 1975, reaching the limits of space at Palomarin, Audubon Canyon Ranch, a local NGO, offered a leased space in Pike County Gulch, the northernmost canyon of Bolinas Lagoon Preserve, that they purchased from Mary and Alan Galloway in 1971. It had a small vacation cottage, and funds were raised by PRBO in 1981 through a matching $70,000 grant from the San Francisco Foundation to build a building for the administrative staff, and quarters for researchers (Figure 3). This served well until 2004 when the generous host, Audubon Canyon Ranch, decided to reclaim the property, prompting a successful capitol campaign and the acquisition of a 14,300 square foot, two-story San Francisco Bay Research Center

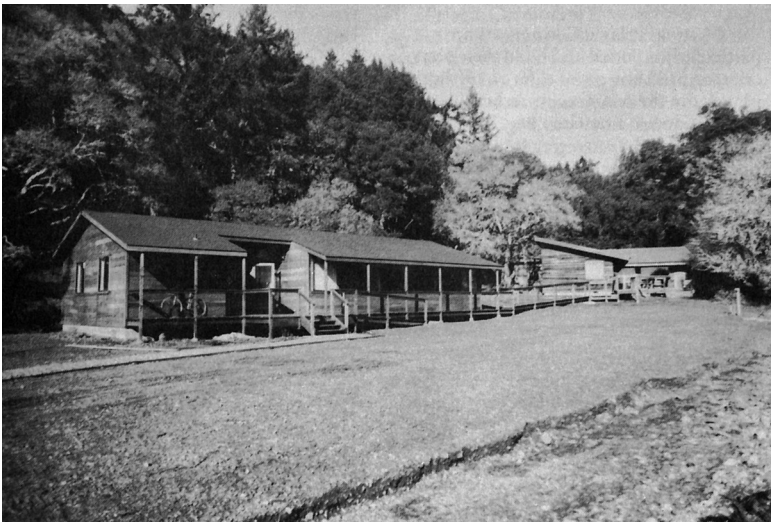

Figure 3. The Observatory headquarters from 1979 to 2005 at Pike County Gulch on the shore of Bolinas Lagoon. 1980 photo courtesy of C. Peaslee.

and Headquarters (Figure 4) in Shollenberger Park near the Petaluma River shoreline and overlooking the tidal marshes of in Sonoma County (Cohen 2004). With help of some no-interest loans by some key foundations and generous new donors, the organization finally had room to grow and the financial foundation to ensure its long-term future.

SUPPORTING AN EARLY NON-PROFIT

Executive Director.—The variety of leadership of the Observatory has been notable (Table 1), as would be expected over more than half a century and their management styles and backgrounds have been many and varied. The first Director in the usual sense, being paid for the job, was probably Ralph in 1966. He, upon return from a half-year's collecting animals in West Africa for various museums, got involved again on the PRBO Board and was offered the job. Working with

Figure 4. Senior Scientist Meredith Elliot with interns doing a bird survey in front of Point Blue Headquarters in background, Petaluma, California. 2016 photo courtesy of L. Arata.

several Board members and friends of the observatory, PRBO quickly gained a "small facilities grant" from the National Science Foundation with the important help of Peter Ames, then at the MVZ.

During the succeeding years, a variety of people took on the leadership, and as to be expected, some had more successful philosophies and ideas than others. Further, the interaction of the leadership and staff with the Board provided many and varied collaborations. Various Executive Director models were experimented with, from scientists, to activists, and people with collaborative skills, all with the goal of assisting the scientists in raising funds. Of the more notable were Fred Sibley, the first after Ralph, a well-known ornithologist who had worked at Yale and on the California Condor Project with the U.S. Fish and Wildlife Service (his son, David (Figure 5) got an early start at PRBO to his later career as an artist and author).

Table 1. Directors (paid) and Presidents of the Board of Directors of the Point Reyes Bird Observatory / Point Blue to present.

Executive Directors and CEOs (paid staff)		Presidents and Board Chairs (volunteers)	
1966	C. John Ralph	1965	L. Richard Mewaldt
1969	Fred C. Sibley	1970	Ben Glading
1970	John Smail	1972	Laurence C. Binford
1976	Jane P. Church	1976	James M. Tasley
1978	David B. and Deborah A. Clark	1978	Robert W. Jasperson
1980	Burr Heneman	1979	John H. Dakin
1984	Donald A. McCrimmon, Jr.	1981	Robert L. Mayer
1987	Laurie A. Wayburn	1983	Jennifer Meux White
1992	Daniel Evans	1984	John H. Dakin
1999	Ellie Cohen	1986	Robert L. Mayer
		1988	Totton Heffelfinger
		1990	Theodore L. Elliot Jr.
		1992	John H. Jacobs
		1994	Ann Stone
		1997	Graham B. Moody
		1998	Jack W. Ladd
		2001	William S. Foss
		2004	Stephan A. Thal
		2007	Stefan Williams
		2008	Carolyn Johnson
		2011	Ed Sarti
		2016	Megan G. Calwell
		2019	Manuel Oliva

Then came John Smail, a British ex-pat whose avuncular style and energy was memorable; Jane Church (Figure 6), a respected collaborator who helped land a major contract with the federal government to document marine resources and open a new headquarters that lasted for 30 years at Audubon Canyon Ranch on the shores of Bolinas Lagoon; Burr Heneman, a well-connected local activist with many strong suits, including communication, media, fundraising and collaboration; Donald McCrimmon, a shorebird researcher from the Cornell Laboratory of Ornithology; Laurie Wayburn (Figure 7), a

Figure 5. The young David Sibley about 1967 removing a bird from a net at Palomarin. Photo courtesy of PRBO.

conservation activist and effective leader; Dan Evans, a Ph.D. researcher from University of California, Davis with international experience; and, most recently, Ellie Cohen (Figure 8), a conservationist activist with exceptional collaborative and fundraising skills. Cohen has the longevity record for all Executive Directors (19 years), moved the headquarters to Petaluma and substantially expanded the mission and influence of the organization to include an energetic embrace of climate change and applied science. She also adeptly increased the programmatic staff including hiring PRBO's first Chief Science Officer, John Wiens (Howell 2008) and significantly increased the

Figure 6. Jane Church Director of the Observatory 1976-1978. 1977 photo courtesy of PRBO.

organization's annual budget from $2.5 million to nearly $14 million today.

Board of Directors.—In the early years, the Board tended to be about a dozen people and later expanded to a score or more. L. Richard Mewaldt as the first President set the standards of involvement and leadership (Ralph 1992) for future Presidents (Table 1). The criteria for Board membership were originally people who were bird-banders and birders. Later Boards included renowned scientists, and always tended to include at least some folks who were conservation-minded, with a business or philanthropic background, and almost always who

Figure 7. Dick Mewaldt, the co-founder, indefatigable investigator, and long-time President of the Observatory, with the tireless Laurie Wayburn, Director 1987-1992. 1990 photo courtesy of C. Peaslee.

appreciate birds. In the more recent decades, the Board has become energized with people with the means to help financially and, those with various contacts in the political and business worlds that matter, and people with big ideas and innovative skills. Many individuals who were strong and important to the growth of the organization had a hefty dose of the 3 Ws of non-profits: Wealth, Wisdom, and Work, always with the idea that two out of three isn't bad.

Funding an observatory.—Raising funds has been a constant effort of the Director, staff, and Board over the years and has been largely

Figure 8. Ellie Cohen, Point Blue's Chief Executive Officer for nearly 20 years at the helm, transformed the organization from 30 to 180 staff and an annual budget of nearly $14 million. 2017 photo courtesy of PRBO.

successful, although lean times have caused for desperate measures. This has, however, enabled the organization to stay afloat and flourish. In 1978, the first Annual PRBO Bird-A-Thon was launched and raised more than $11,000. It has continued in most years to the present and was recently renamed the Rich Stallcup Bird-A-Thon, raising well over $3 million over the nearly 40 years.

Throughout this account you will see notes of grants or bequests. Among the significant early ones were the 1970 grant from the Merrell

Trust for $30,000 for a landbird biologist and education director, the San Francisco Foundation grant of almost $330,000 for operating expenses over a five-year period under Burr Heneman (Figure 9) in 1980, regular support in the hundreds of thousands of dollars from the David and Lucille Packard Foundation for key new programs, and most recently millions of dollars for work on water-related issues from the S. D. Bechtel Jr. Foundation. A most notable and timely bequest was of $1.7 million in 2008 from an exceptionally generous founding member: Dorothy Hunt (Peaslee 2009)

Science guidance: role of a science advisory board.—Prominent scientists from California universities (the majority from University of California at Berkeley and Davis, and Stanford University), and occasionally from out of state institutions (such as Washington State University) filled 2–4 positions on the Board. In addition to adding scientific credibility to the organization, their role included assisting staff in writing scientific proposals and manuscripts, helping staff to

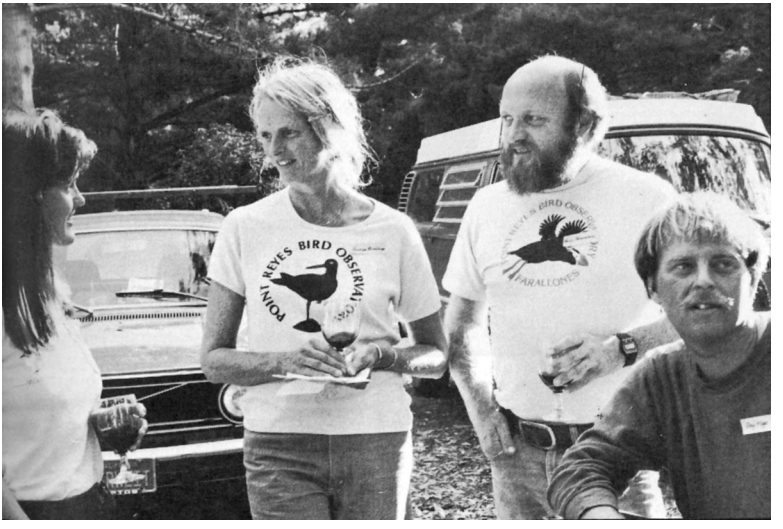

Figure 9. Lynne Stenzel, Frances Bidstrup, Burr Heneman (Director 1980-1984) and Gary Page share camaraderie at an Annual Meeting about 1983. Photo courtesy of C. Peaslee.

establish connections in the academic and scientific communities and interpretation of results to the non–science Board members. From the first years, an Advisory Board was active including luminaries of science and business. It was formalized in the 1990s as a Scientific Advisory Committee (SAC) and was established to increase the role of scientists, who may not have the time to participate as regular Board members but would help set future directions for the organization's research. They operate typically by promoting a current and highly relevant theme often identified by senior staff, in consultation with the SAC. This is followed by an annual day-long symposium/retreat with SAC members and other scientists with expertise in the field. Many notable directions of Point Blue have emerged from this process including current focus and advances involving riparian conservation, informatics (information science), climate-smart conservation, and private lands conservation.

Science staff.—One of the fundamentals to the success of the organization is the commitment and dedication of the science staff. As demonstrated by the founders and the countless hours of volunteer labor the 'work' at Point Blue was always much more than a job. The number of volunteers, interns, and the longevity of many of the senior staff (many with over 30 years of service) shows the passion for the mission of the organization. According to the organization's Strategic Plan, at the core of everything the science staff does is: "Scientific rigor, Collaboration, Innovation, Excellence, Nature, Complete integrity and Everyone is responsible" (SCIENCE).

Point Blue also has established an 'Integrity Policy' on scientific and scholarly activities for all of its staff, interns, research associates, and volunteers (a full copy is available on the organization's web site). It is essential that those associated with Point Blue maintain the codes described, for these are critical factors that inform decision making on a wide array of public and private policies. In addition, the scientific method is at the heart of Point Blue's identity as a science-based institution.

Recent growth, expansion, and name changes have put renewed emphasis on the organization to maintain its culture, vision, and mission. Leadership has focused on improving communication (especially with many staff now working remotely), transparency of decision making and inclusiveness. Regular (every 5 years) strategic

planning includes all staff and board, and actions and outcomes are aligned regularly. A sound, annual review process and monthly review of work plans help keep staff focused and integrated. Providing staff with regular training, opportunities for advancement and wellness activities are crucial for maintaining staff morale and longevity. Also, participation in scientific conferences, teaching opportunities, membership on boards, and collaborative initiatives, and community engagement are all critical ingredients for an inspired workforce. Finally, the realization that 'everyone is a fundraiser' is a key element, and also allowing interns and volunteers to share their passion for nature and conservation with the public, has proved to be extremely effective in sustaining the organization.

Role of interns.—A key to the growth of the organization has been the 'intern/volunteer business model.' Although some criticism in various forums has been raised about using volunteer and intern biologists (e.g., Fournier and Bond 2015), we maintain that with proper management (see Gardali 2010), it provides important and relevant field training with experts that many colleges and universities no longer support. As alluded to above, it is extremely important to immerse interns in all aspects of working in natural resources (not just data collecting, but analysis, interpretation, fundraising, and teaching). We have found that interns and volunteers can be outstanding spokespersons for the organization, as the passion they have for their work is contagious.

Interns with new knowledge and passion also provide a source of inspiration for the staff who work with them. They often become a trusted entity that can allow projects to expand or the organization to take on new projects. Many interns go on to professional positions in university and government agencies and become key collaborators in future projects. For example, these factors allowed the Terrestrial Program to grow substantially in the late 1990s (from an annual budget of $150,000 in 1998 to $2.5 million in 2010) and was the origin of many of the Point Blue's most successful ongoing programs (e.g., Farallones, Sierra Nevada, and San Francisco Bay).

Membership.—Historically, the number of members changed significantly during the first few years, reaching 1,000 in April 1970. Within a decade it was at 2,000. In recent years, however, it has dropped

down and is maintaining itself at about a thousand over the last few years (Pete McCormick, in litt.). However, despite the recent apparent lack of emphasis, membership does provide an important introduction to Point Blue through the newsletter, annual reports, and events such as annual meetings, field trips, excursions, and annual fundraisers. Many big donors and enthusiastic collaborators are cultivated through either being a member or attending a membership event. The cost of such events and outreach deserves to be carefully managed and their impact evaluated on regular basis to determine if increased emphasis should be devoted to such efforts.

Collaborators and descendant organizations.—Collaboration is key to the success of any science-based NGO. In the 2015–2016 annual report, Point Blue listed 289 active collaborators (organizations) from over 11 different countries. Although, until recently, Point Blue owned no assets (land or buildings), it influenced the management and stewardship on millions of acres of both public and private land. For example, Point Blue in partnership with the Natural Resource Conservation Service (NRCS) is working on over 700 active ranches in California to employ sustainable grazing and management practices on almost 500,000 acres of land to achieve climate-smart conservation outcomes. While private sources of funding are critical to Point Blue's financial stability and brings a great deal of added value, government contracts are also critical to allow Point Blue to be relevant and use its science to influence key partners especially those that manage habitat.

Furthermore, Point Blue maintains close connections with many of the NGOs it helped spawn or fledge, including sharing of staff and interns, joint proposals and publications, and funding opportunities. These have included many direct or lineal descendants, including: Alaska Bird Observatory (now Alaska Songbird Institute), Bird Ecology and Conservation Ontario, Colorado Bird Observatory (now Bird Conservation of the Rockies), Costa Rica Bird Observatories, Great Basin Bird Observatory, Humboldt Bay Bird Observatory, Klamath Bird Observatory, Institute for Bird Populations, Idaho Bird Observatory (now Intermountain Bird Observatory), Louisiana Bird Observatory, San Francisco Bay Bird Observatory, San Pancho Bird Observatory, and many, many others.

Major programs areas and projects they spawned.—Over the years, various organizational themes have been used. After the first decade, PRBO was basically an independent collection of scientists, each serving as Principal Investigator and in charge of their own funding. In the 1970s, as the organization matured, and projects expanded, the organization was centered around the scientists leading in four major areas: Education; Terrestrial Birds (at the Palomarin Field Station); Shorebirds (in and around Bolinas Lagoon, Mono Lake, and the beach-dwelling Snowy Plovers of the central California Coast); and Marine Birds (on the Farallones and in Antarctica). In the 1990s, as the observatory programs expanded and highly collaborative bird conservation initiatives (such as Partners in Flight and U.S. Shorebird Conservation Partnership) were launched, Point Blue's research and conservation goals became more explicit and were used to form innovative new partnerships across the continent. In the early 2010s, to integrate the staff, and overarching conservation themes (e.g., climate change, habitat restoration, training) Point Blue formed Groups that were either place-based (e.g., Sierra Nevada, Central Valley,) or thematic (e.g., Informatics, Climate Change). In 2011, Point Blue acquired the "Students and Teachers Restoring a Watershed" (STRAW) from The Bay Institute and put it under the Education and Outreach Group. To further integrate staff and projects across these Groups, a 5-year strategic plan was developed that focused on the following six initiatives: securing water and wildlife on working lands; protecting our shorelines; conserving ocean food webs; catalyzing climate-smart restoration; making conservation policies and plans climate-smart; and training the next generation. Each initiative has a core team, a business model, and specific outcomes that are measurable and prioritized regularly by staff and Board.

To describe the basic history of the different Groups, we will follow the 1990s designation (that lasted for 20 years) known as "Programs." These include Terrestrial, Marine, Shorebird, Education, and (more recently) Informatics. Under these, we will, for convenience, refer to individual Projects focused on species, sites, or ecosystems.

TERRESTRIAL AND LANDBIRD PROGRAMS

Palomarin and the Point Reyes National Seashore.—The very first banding under the PRBO permit was done by Jared Verner and Marilyn

Milligan, then graduate students at University of California, Berkeley in July 1965 (Verner and Milligan 1971). Shortly thereafter, Howard Cogswell (Figure 10) and Bob Stewart started a spring migration study called Operation Transect at a riparian area very near the Heims Ranch (Stewart 1971). A year later, in 1966, when the observatory had moved to the Palomarin Field Station near Bolinas, PRBO initiated the longest continuous population study of songbirds in the western U.S. with several initial emphases, all using mist nets and traps, including: compositions and age differential of migrant song birds (Ralph 1971); life histories of Warbling Vireo (*Vireo gilvus*) (Ralph 1967), Pacific-slope Flycatcher (*Empidonax difficilis*) (Ralph 1968b), Chestnut-backed Chickadee (*Poecile rufescens*) (Hooper 1968), and Wilson's Warbler (*Cardellina pusilla*) (Stewart 1969, 1973); home range, territory size, and dispersal patterns of several species (Ralph and Pearson 1971, Halliburton and Mewaldt 1976) and the infamous song dialects and life history traits of resident Nuttall's White-crowned Sparrows (*Zonotrichia leucophrys nuttalli*) (Mewaldt et al. 1968, Baptista 1975, Mewaldt and King 1977, Baker and Mewaldt 1978, Baker et al. 1981). Mewaldt (Figure 7) obtained a two-year grant of $27,200 (more than $200,000 in 2018 dollars) from the National Science Foundation entitled "Zonotrichia of Point Reyes National Seashore" with resident PRBO biologist Ted Van Velzen paid half-time from the grant. Research on White-crowned Sparrow dialects continues today based at Palomarin with researchers from Tulane University (Derryberry et al. 2016).

Mist nets were operated at the Palomarin station starting in 1966. In the early years, mist nets were run essentially continuously, on most days and, at times, for 24 hours. The primary purpose was to monitor the life history and abundance of residents and migrants year around. Additionally, the mist-net captures and banding demonstrations were used for educational and outreach purposes and to determine where individuals, especially out of range vagrants, were wintering and breeding. Many people who have participated in this effort have gone onto careers in the field. Importantly, for many visitors this is the only, and overwhelming favorable impression of the organization's science. This is in no small part the result of the many very friendly volunteers, interns, and staff who drew people in. Among the most notable staff was Bob Stewart (and his then wife Meryl) who began to volunteer in 1968 and went on to be the chief bander, conducting many studies, before leaving in 1977.

Figure 10. Fran Mewaldt (wife of Dick) presenting founding member, Howard Cogswell, with a "Founder's Award," with Laurie Wayburn (Director 1987-1992) looking on, about 1992. Photo courtesy of C. Peaslee.

Forty-five years later, we have finally met the objective of a full cycle life history for two species during their time in California (i.e., breeding Swainson's Thrushes [*Catharus ustulatus*] and wintering Golden-crowned Sparrows [*Zonotrichia atricapilla*]) using geolocators and recaptures from nest and traps (e.g., Seavy et al. 2012b, Cormier et al. 2013, 2016) (Figure 11).

Along the way, there were a few bumps in the road. About 1975, Mewaldt (*in litt*.), concerned with a lack of banding effort and declines in captures, made a plea to the Board for having a ". . . Biologist (female or male) hired, whose primary duty would be to oversee an all-year capture, banding, and recapture program at Palomarin," and indicated funds would be raised from Dorothy Hunt of Aptos, and himself. Subsequently, a tidy sum was garnered annually towards this end. As a result, a full-time bander, Bruce Sorrie, began work in 1976 for about two years, and he began to standardize the mist-netting. Then a sea-change occurred with the hiring of David DeSante (Figure 12) who was

a professor at Reed College and well known for his Farallon Island warbler misorientation research and Ph.D. dissertation at Stanford (DeSante 1973). With encouragement from Mewaldt, David Ainley, and science members of the board, the netting operations at Palomarin were finally fully standardized (run a set number of hours) and made year-round (not just in migration or for group visits) beginning in April 1976 (DeSante *in litt*.). This approach, called 'constant effort mist-netting,' yielded extremely valuable data on the relationship between productivity and rainfall and, among many accomplishments, documented an unprecedented reproductive failure in 1986, suggested to be linked to the Chernobyl radioactivity rainfall (DeSante and Geupel 1987). Now, led by The Institute for Bird Populations, this approach has been replicated across North America and has yielded many important scientific advances, including, for example, vital rates for 158 landbird species in North America (DeSante et al. 2015).

Figure 11. Volunteers about 1965 removing a White-crowned Sparrow at Palomarin: Carol Pearson (Ralph, left) and Gail Jenkins. Photo courtesy of PBRO.

In 1979, following extensive internal review and a desire by the Scientific Board to expand the research, a comprehensive life history study of resident coastal scrub birds was started by DeSante (1979) using individually color-marked birds to compile year-round life histories and key demographic parameters such as productivity, survival, and dispersal by direct observation. The intern crew in the spring of 1980 showed that nests of most of these coastal scrub songbirds could be located and monitored in systematic fashion without influencing predation (Martin and Geupel 1993) and perhaps more importantly they created the first *Palomarin Handbook* that

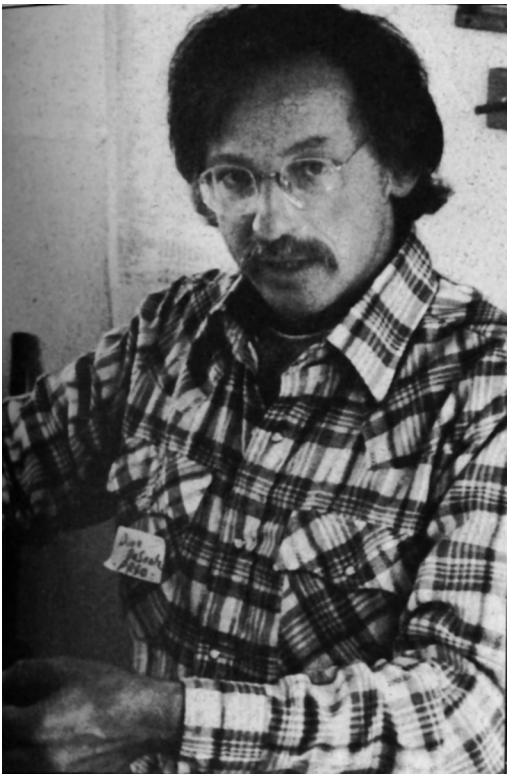

Figure 12. Dave DeSante about 1978 who headed the landbird program, headqartered at the Palomarin Field Station, for 10 years. 1978 photo by C. Peaslee.

standardized the approach to all data collection (Kjelmyr *in litt*.) and updated versions remain the fundamental resource for operation of the field station (Point Blue Conservation Science 2018). In 1982, the field station received its first donated personal computer for data entry to enter current data (the day it was collected) and to begin the arduous task of entering past data. Over the next two decades the comprehensive data entry, proofing and management system at Palomarin ultimately lead to Point Blue's current leadership role in the Avian Knowledge Network which contains well over a half billion bird and other records (Ballard *in litt*.).

The numerous scientific contributions of the Palomarin Field Station have recently been summarized by Porzig et al. (2012). They include many methodological studies on population demography that are now used throughout the Americas (Ralph et al. 1992, 1996, Martin and Geupel 1993, Geupel and Warkenton 1995, Latta et al. 2005), validations of these methods (Nur and Geupel 1993, Silkey et al. 1999, Ballard et al. 2004, Nur et al. 2004, Jennings et al. 2009, Spotswood et al. 2012), dispersal and survival (Baker et al. 1995), long-term single species demography (Geupel and DeSante 1990, Johnson and Geupel 1996, Chase et al. 1997, Gardali et al. 2000), bird responses to climate change (Dybala et al. 2013), and community dynamics (Porzig et al. 2014, 2016, 2018). The Palomarin Field Station and its long-term data sets, intern training program, and cutting-edge research remains one of the flagship operations of the organization as it continues to connect people with birds, research and applied conservation (Seavy 2013).

Beyond Palomarin.—Beginning in the 1990s under Geupel's (Figure 13) leadership, the Terrestrial Program began to expand beyond Point Reyes using the many standardized survey techniques pioneered at Palomarin. An important step was in 1992 when Point Blue biologists helped start the California portion of Partners in Flight (PIF), a coalition of agencies, nonprofits, and individuals working to "Keep Common Birds Common" (PRBO 1993, Evans 1995). As part of PIF, Point Blue collaboratively developed and produced, through shared authorship with numerous partners, nine multispecies songbird Habitat Conservation Plans: riparian, oak woodland, coastal scrub, chaparral, coniferous forests, sagebrush, desert, grassland, and Sierra Nevada (Geupel 1997, 2000, Zack et al. 2005, Hammond et al. 2018). Using the focal species concept (Chase and Geupel 2005), all but one of these

plans use a suite of bird species as indicators of habitat condition and function for every major habitat in California and have been used throughout the continent by conservation practitioners. The PIF riparian plans (RHJV 2000, 2004) and resulting conservation actions sparked its own state sponsored 'Riparian Habitat Joint Venture' modeled after the USFWS Migratory Bird Program's habitat joint ventures with dozens of federal, state, and non-government collaborators (Laymon 1995). PRBO hosted the coordinators as staff for over a decade and helped to produce regular statewide conferences with state-of-the-art applications on the conservation and management of California riparian systems.

Shuford and Gardali (2008), in collaboration with California Department of Fish and Game and multiple authors writing species accounts, published the landmark book *California Bird Species of Special Concern*. The first update by the state since 1978, it describes the species most in need of conservation and is used to set mitigation

Figure 13. Geoffrey Geupel, author and Point Blue biologist and Group Director for nearly 40 years, removing one of tens of thousands of birds from mist nets at the Palomarin Field Station about 1990. Photo courtesy of C. Peaslee.

regulations for the state California Environmental Quality Act. Gardali et al. (2012) followed this with a climate-change vulnerability assessment of all California at-risk birds.

Central Valley watershed.—In 1991, a major toxic chemical spill occurred in the Sacramento River (termed the "Cantera Loop Spill"). Ralph was contacted by California Department of Fish and Game and immediately involved PRBO in implementing monitoring. PRBO was contracted to assess populations of landbirds. The then novel approach of using mist-netting and nest searching to assess the impact of the spill to the demography of the various birds, contributed to a $14 million settlement by the Southern Pacific Railroad and expanded PRBO's long-term songbird monitoring to the Great Valley of California and beyond.

In 1992, monitoring stations were set up along the newly formed units of the Sacramento River National Wildlife Refuge. The river for the next 10 years was undergoing extensive re-vegetation and restoration by The Nature Conservancy and River Partners in cooperation with the U.S. Fish and Wildlife Service (USFWS). Under Tom Gardali's (Figure 14) continued leadership, bird response data were used to evaluate the success of these restoration efforts (Golet et al. 2003, Gardali et al. 2006) and became an example of how to use birds to conserve western riparian ecosystems (e.g., Geupel and Elliot 2001). Using birds to evaluate and guide riparian conservation efforts spread to these systems throughout the state including Cosumnes River, Mokelumne River, San Joaquin River, and Clear Creek in Trinity County, with many of the sites still currently monitored (e.g., Burnett et al. 2005, Small et al. 2007, Nur et al. 2008, Latta et al. 2012b), with results guiding conservation planning in the San Joaquin River (Seavy et al. 2012a) and setting populations objectives for songbirds in the California Central Valley riparian ecosystems (Dybala et al. 2017). Other more directed research has focused on conservation of the state endangered Yellow-billed Cuckoo (*Coccyzus americanus*) (Dettling et al. 2015).

Sierra Nevada (contributions by Ryan Burnett).—When Dave DeSante joined PRBO he brought with him a study he began in 1977, the "Sierran Subalpine Landbird Study" a widely-regarded demographic investigation near Tioga Pass in Yosemite National Park (DeSante 1981,1990).

Beginning in 1997 Point Blue began a small project inventorying bird populations in the Lassen Peak region of California in collaboration with the Lassen National Forest and Lassen National Park. In 2002, it was invited by the USDA Forest Service to collaborate on an Administrative Study investigating the effects of fuel treatments in the northern Sierra Nevada Mountains. This project under Ryan Burnett's (Figure 15) leadership led to an extensive Sierra Nevada presence that has involved evaluating effects of fire, aspen restoration, and eventually to a Sierra-wide Bioregional Avian Monitoring Program

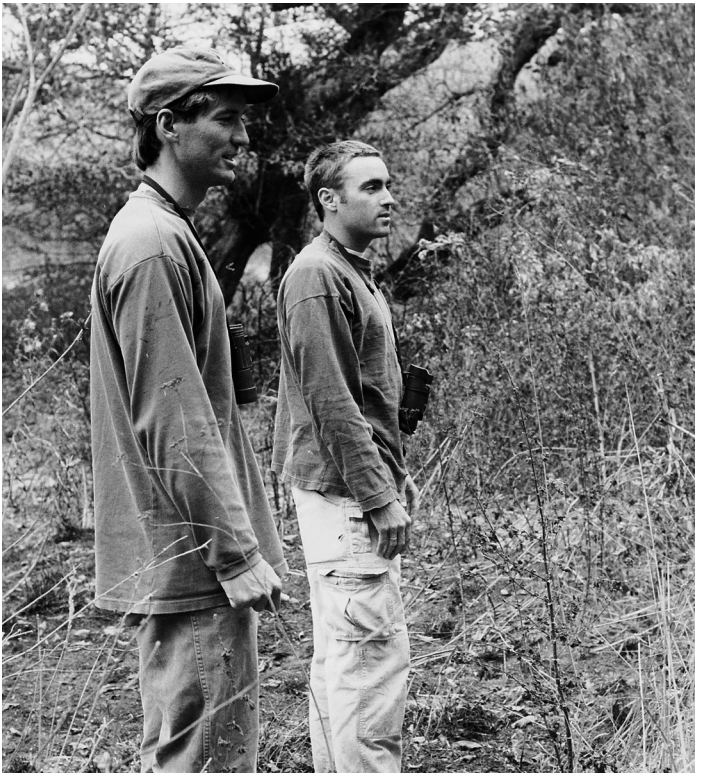

Figure 14. Grant Ballard (left) Informatics leader for Point Blue and now Chief Science Officer with Tom Gardali Group Director and ecologist extraordinaire about 1995. Photo courtesy of D. Evans.

(http://data.prbo.org/apps/snamin/; Fogg et al. 2014; Burnett and Roberts 2015). Point Blue's conservation partnerships in the Sierra Nevada continue to grow as evidenced by Ryan's current leadership of the Sierra Meadow Partnership (Drew et al. 2016) which has a goal to restore 30,000 acres of Sierra meadows by 2030.

San Francisco Bay (contributions by Julian Wood and Nadav Nur).—PRBO's San Francisco Bay Program got its start in 1996 with a grant from the U.S. Geological Survey's Species at Risk Program to evaluate the status and make recommendations regarding listing for five endemic tidal-marsh dependent subspecies of concern: three tidal marsh Song Sparrow (*Melospiza melodia*) subspecies, the Saltmarsh Common Yellowthroat (*Geothlypis trichas sinuosa*), and the California Black Rail (*Laterallus jamaicensis coturniculus*) (Nur et al. 1997, Evens and Nur 2002). Under Nadav Nur (Figure 16) and Julian Wood leadership, Point Blue is now in its 22nd year, assessing temporal and spatial variation in abundance of the three target species. The project objectives broadened to include determination of the key habitat and landscape features promoting robust populations and inform tidal marsh restoration design and monitoring (Spautz et al. 2006). By 2000, program biologists began studying restored tidal marshes as part of large-scale, inter-disciplinary projects aimed at understanding the trajectory of tidal marsh restoration, and what may influence the time course and endpoints of restoration (Stralberg et al. 2010). Point Blue biologists worked with teams spanning many disciplines ranging from physical processes to primary production to fish and birds, all working to guide restoration design and monitoring restoration success to inform adaptive management.

In the mid-2000s, partnerships were extended, thus leveraging the science to influence conservation decisions at higher levels. In 2005, comprehensive surveys of the federally endangered San Francisco Bay Ridgway's Rail (*Rallus obsoletus obsoletus*) and the development of methodology and analyzing survey data from federal, state, and regional agencies began (Wood et al. 2017). For the recent "State of the San Francisco Estuary Reports" in 2011 and 2015, SF Bay Program scientists have led the teams assessing numerous bird and mammal indicator species, revealing the state of ecosystem health at the regional and sub-regional levels. SF Bay Program scientists served on various committees, helping to shape the Climate Change Science Update to the

Figure 15. Ryan Burnett long-term director of the Sierra Nevada Group surveys birds after a recent fire in 2016. Photo courtesy of K. Etzel.

original Baylands Goals document which has resulted in over 30,000 acres of tidal restoration projects in San Francisco Bay (Nur and Herbold 2015).

The SF Bay Program asserted its leadership on climate change with the release in 2010 of the Future Marshes Climate-Smart Planning Tool (www.pointblue.org/sfbslr; Stralberg et al. 2011b, Veloz et al. 2013, 2014) to inform decisions about adaptation planning and restoration potential given different sea-level rise scenarios. This tool and others (e.g., Our Coast Our Future www.pointblue.org/ocof), opened doors to new partnerships with city, county, and regional climate change adaptation planners, giving Point Blue opportunities to promote

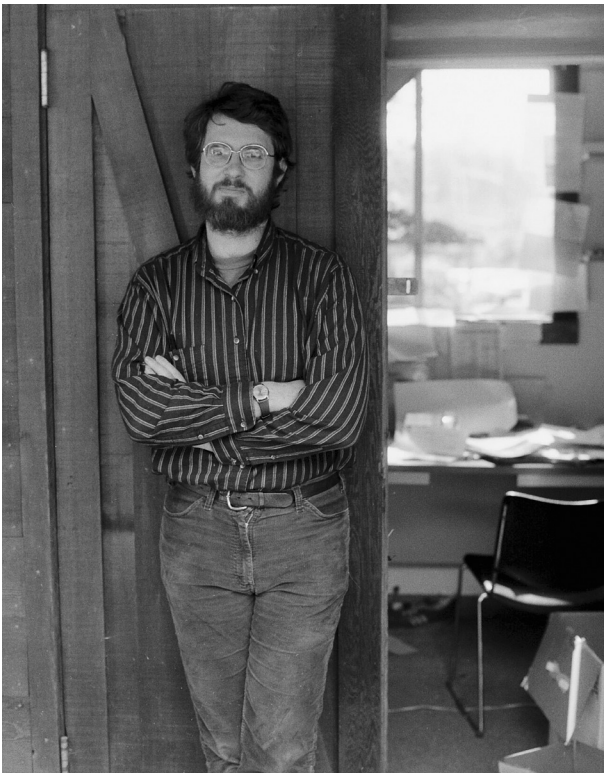

Figure 16. The long-time quantitative biologist Nadav Nur who provided statistical guidance to generations of PRBOers. Photo by C. Peaslee.

resilient tidal marsh ecosystems and other nature-based solutions as key components in climate change vulnerability assessments and implementation plans, benefitting wildlife and humans. (Figure 17).

Eastern Sierra (contributions by Sacha Heath).—Point Blue has been conducting avian research in the Eastern Sierra Nevada region since the early 1970s, when Stewart et al. (1974) documented divergent age ratios of fall migrant passerines between coastal and inland regions of California. The 1980s saw a flourish of research by PRBO's Wetlands Ecology Division on the breeding ecology of Snowy Plovers (*Charadrius nivosus*) at Mono Lake (Page et al. 1983, 1985, Warriner et

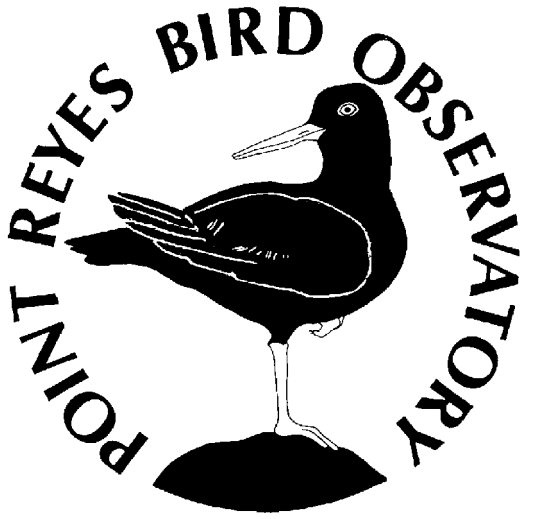

Figure 17. The orginal logo of PRBO crafted by Henry Robert, the first Farallon biologist in 1965. Photo courtesy of PBRO.

al. 1986), contributing to the first statewide breeding distribution survey of the species (Page et al. 1991). These data, combined with plover monitoring data from Owens Lake (Ruhlen et al. 2006), supported the decision to list the interior population of Snowy Plovers as a California Bird Species of Special Concern (Shuford et al. 2008) (Figure 18). Remaining a stellar example of Point Blue's commitment to long term datasets, plover research at Mono Lake continues to this day, allowing for explorations of the temporal and spatial effects of a changing environment on changing plover populations (Shuford et al. 2016).

Spurred by statewide conservation efforts to monitor and conserve breeding birds in riparian habitats (RHJV 2000), PRBO reignited passerine research and conservation efforts east of the Sierra crest in 1998. Recognizing that most waterways of the region ran through a mosaic of management jurisdictions, and the implications this could have for monitoring and conservation efforts, projects took a highly collaborative approach, engaging and working alongside multiple land management and water agencies, regional conservation groups, and

academic institutions. Studies aimed at describing ecological patterns in riparian breeding bird communities began in the relatively undocumented region of the alluvial fan region of the Owens Valley (Heath and Ballard 2003a) and continued for over a decade and across an approximately 250-km latitudinal stretch of the Eastern Sierra Nevada region (Heath and Ballard 2003b). These efforts found that in comparison to several other riparian vegetation types, aspen riparian at higher latitudinal and elevational regions, and black willow riparian at lower latitudinal and elevational regions, supported the highest breeding bird diversity (Heath and Ballard 2003b). The aspen result lead to further research documenting negative correlations between conifer encroachment and bird diversity in aspen groves (Richardson and Heath 2004), and the monitoring of bird communities in response to conifer removal and aspen regeneration projects on Bureau of Land Management lands (Point Blue unpublished data). A study in high elevation aspen groves documented nest survival and cowbird

Figure 18. Dave Shuford the expert bird ecologist at Point Blue for over 40 years led research on California Gulls at Mono Lake in 1983. Photo courtesy of B. Henneman.

parasitism in common aspen-nesting species and found that Warbling Vireos suffered near total nest failure due to Brown-headed Cowbird (*Molothrus ater*) parasitism (Heath et al. 2010). The black willow result led to further examinations of bird community patterns in relation to water diversions and loss of these important habitats along the Lower Owens River (PRBO unpublished data). These studies, among others, contributed findings and recommendations to a revised version of the Riparian Bird Conservation Plan (RHJV 2004).

In collaboration with graduate students who had previously been trained as interns in Point Blue's eastern Sierra projects, Point Blue focused its research and monitoring on the breeding ecology of songbirds nesting along tributary streams of Mono Lake which were being restored after decades of water diversions (Heath et al. 2006a, 2006b). Monitoring efforts found that parasitism by cowbirds contributed to low nest survival among several host species at Mono Lake, prompting Tonra et al. (2008, 2009) to examine the impacts of songbird nesting habitat and cowbird nestling sex on hatch synchrony between cowbird and host eggs, and Croston et al. (2012) to examine flange color matches of cowbird and host nestlings, each having potential implications for competitive advantage of cowbird nestlings over their hosts. Yellow Warblers (*Setophaga petechia*) were nesting in very high densities along these streams and yet were suffering low nest survival rates due to predation by a number of different predators (Latif et al. 2012a) and because they were maladaptively selecting nesting microhabitats associated with higher nest predation risk than available alternatives (Latif et al. 2011). These and other findings (Latif et al. 2012b,c) supported the inclusion of Yellow Warblers among the California Bird Species of Special Concern and contributed to management and monitoring recommendations for the species (Heath 2008). This research also revealed new and interesting natural history findings, including the first evidence of conspecific brood parasitism and egg rejection in Song Sparrows (Latif et al. 2006).

Arid lands in California and beyond (contributions by Aaron Holmes and Chris McCreedy).—The Shrubsteppe Program started in 1995 as part of the Terrestrial Division with a project on the Naval Weapon Systems Training Facility in Boardman, Oregon. For three years, nesting and survey data were gathered on the local breeding populations of Loggerhead Shrike (*Lanius ludovicianus*), Long-billed

Curlew (*Numenius americanus*), Burrowing Owl (*Athene cunicularia*), and the entire association of shrub steppe songbirds including Grasshopper and Sagebrush Sparrows (*Ammodramus savannarum* and *Artemisiospiza nevadensis*). Publications from these studies include using survival time analysis for nest success (Nur et al. 2004b), impacts of altered fire regimes (Humple and Holmes 2006, Holmes and Miller 2010), and impacts of prescribed fire and livestock grazing (Holmes 2007).

From this single project, in 2000, PRBO and then Point Blue launched a major program focused on conservation of the shrub-steppe that included projects in eastern Oregon, northern California, Nevada, Washington, and Wyoming. Notable staff who contributed to the success of the program and supervised a growing army of field biologists include Diana Humple, Dan Barton, Adam Hannuksela, and Allison King. Their research and monitoring projects had a common thread of investigating the ecological and anthropogenic determinants of bird distribution, abundance, and demographics—including impacts of energy development in Wyoming, off-road vehicles in California (Barton and Holmes 2007), and fire ecology in both altered and relatively pristine locations (Knick et al. 2005, Earnst and Holmes 2012, Holmes and Robinson 2013, Holmes et al. 2017). These projects continued to inform the Partners in Flight Initiative and were the foundation of regional Partners In Flight conservation plans for sagebrush habitats in Oregon (Altman and Holmes 2000), and California (CalPIF 2005). The program continues through Point Blue's Rangeland Watershed Initiative and with Point Blue and Natural Resources Conservation Service (NRCS) with what is termed the "Partner Biologist" Program, located in Alturas and Susanville California. Partners, mostly working through The Sage Grouse Initiative and NRCS's Wetland Reserve Easement program, now include the Intermountain West Joint Venture, U.S. Fish and Wildlife Service's Partners Program, Bureau of Land Management, Ducks Unlimited, Northwest Wildlife Science, Klamath Bird Observatory, and Bird Conservation of the Rockies.

PRBO's Desert Program began in 2002, initially as part of the Terrestrial Division's Eastern Sierra Nevada Program. The Desert Program's initial objectives were to implement monitoring in order to fill data gaps and provide management recommendations to the

Riparian Bird Conservation Plan (RHJV 2004) and California Partners in Flight's Desert Bird Conservation Plan (CalPIF 2009).

Contemporary data on bird communities was lacking throughout the Mojave and Sonoran deserts, particularly in non-riparian habitats. In response, PRBO and the Bureau of Land Management initiated a long-term monitoring study (2003–2012) of the xeric riparian washes of the Sonoran Desert in southeastern California and southern Arizona. These desert washes are of critical importance for both migrating and breeding birds, and data from this study have provided both a foundation for CalPIF and Sonoran Joint Venture (SJV) conservation plans, and as guidance for desert land agencies that must balance desert conservation with alternative energy development. The SJV, Point Blue, Great Basin Bird Observatory, and Cornell Laboratory of Ornithology collaboratively launched a unique 'Avicaching Program' through eBird to motivate citizen scientists to collect data in under-sampled and remote areas of the desert threatened by energy development (https://ebird.org/news/desert-avicaching-with-the-sonoran-joint-venture/). The program encourages volunteers to go to specific sites to record birds and rewards observers with the most visits with donated prizes.

Point Blue has also directed a long-term study that monitors the desert riparian bird community's response to restoration (involving invasive tamarisk removal and Brown-headed Cowbird trapping) on the Amargosa River in the eastern Mojave Desert. This project has recorded dramatic increases in density and productivity for all species following cowbird trapping, illustrating that cowbird management is a powerful tool that both ameliorates declines of various bird species following tamarisk removal, and speeds re-occupation of restored habitats by boosting productivity from nearby source populations (McCreedy and Warren 2015). Other studies have shown desert bird populations' response to prolonged drought (McCreedy and van Riper 2014). The Desert Program continues to maintain projects and partnerships ranging from the Bureau of Land Management, Los Angeles Department of Power, the California Fish and Wildlife in Bishop, to the University of Arizona and Sonoran Joint Venture.

Latin American (Contributions by Borja Milá and Steve Latta).—In the early 1990s, although several monitoring stations across North America were generating important information during the breeding

and migratory seasons on population trends and productivity for many landbird species, it became apparent that information on the non-breeding season was severely lacking. Birds spent up to nine months south of the USA-Mexico border, yet the dearth of monitoring stations in this vast region meant that birds were not being monitored throughout their life cycle, and thus changes in population size could not be tied to specific events in the breeding or wintering periods. In addition, in many cases we knew very little about the natural history or population trends of permanent resident species in Latin America, so any efforts towards conservation and management of these species was impacted. To help alleviate this lack of information, Ralph and Geupel helped PRBO biologist Borja Milá, with funding from the USDA Forest Service's International Office, launch PRBO's Latin American Program in 1993 in partnership with the Forest Service's Redwood Science Laboratory. This joint program had three main objectives: (1) to produce and disseminate bird monitoring and migratory bird conservation materials in Spanish and English, (2) to provide training workshops in bird monitoring methods to Latin American biologists and wildlife managers, and (3) to help establish long-term, constant-effort landbird monitoring stations in Mexico and Central America.

To start, PRBO published field methods for monitoring population parameters of landbirds in Mexico based on a Smithsonian sponsored workshop in Mexico (Geupel and Warkentin 1995) and, with Ralph and others, produced a Spanish version of the popular Forest Service *Handbook of Methods, for Monitoring Landbirds* (Ralph et al. 1996), which is still used extensively. To communicate more effectively across borders, a bimonthly, bilingual newsletter called "La Tangara" was produced by Milá and sent out to a mailing list of over 2,000 people in the Partners in Flight network. The Latin American Program also coordinated and taught 14 courses in field ornithology with collaborators in Mexico, El Salvador, Costa Rica, and Panama. The two-week long courses included class presentations on avian ecology and conservation, monitoring methods, project design and basic data analysis, as well as field practice in various ornithological techniques including species identification, mist netting, counting methods, and nest monitoring.

Over the years, courses were conducted in collaboration with colleagues in local Latin American institutions, including Eduardo Santana and Sarahy Contreras at Instituto Manantlán de Ecología y

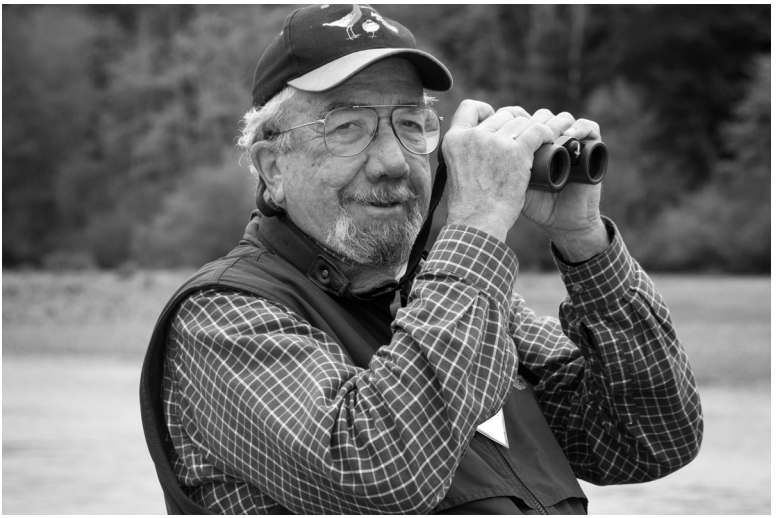

Figure 19. C. J. Ralph, author and a co-founder of Point Reyes Bird Observatory and its first Director (1966-1969) in the field (2015). Photo courtesy of D. Price.

Conservación de la Biodiversidad (IMECBIO), Universidad de Guadalajara, Jalisco, Mexico; Laura and Fernando Villaseñor at Universidad Michoacana San Nicolás de Hidalgo, Michoacán, Mexico; Fernando Urbina at Universidad Autónoma de Morelos, Morelos, Mexico; Javier Salgado at Universidad Autónoma de Campeche, Campeche, Mexico; Comisión Nacional de Areas Naturales Protegidas in Mexico, Daniel Hernández at Universidad Nacional, Heredia, Costa Rica; Sistema de Parques Nacionales, Tortuguero, Costa Rica; Asociación Nacional para la Conservación de la Naturaleza (ANCON), Ciudad de Panamá, Panamá; and Oliver Komar at Universidad de El Salvador, San Salvador, El Salvador.

More than 200 biologists were trained in these courses, and many of them developed successful monitoring programs in the region. Two particularly prominent constant-effort programs were those implemented in the Sierra de Manantlán Reserve by Eduardo Santana and Sarahy Contreras and on the coast of Michoacán established in collaboration with Laura and Fernando Villaseñor.

In Costa Rica in 1993, Ralph with Daniel Hernández from Universidad Nacional, established a monitoring station in Tortuguero that included mist nets and a large Heligoland trap made of bamboo and plastic mesh that successfully sampled birds during migration (Figure 19). That budding station turned into 14 long-term monitoring stations, still run today by the Costa Rica Bird Observatories under Pablo Elizondo and Ralph. The observatory provides bands and support for all bird researchers in the country.

Under the direction of Steven Latta from 2002–2006, and with primary funding from the Richard and Rhoda Goldman Fund and an anonymous donor, the Latin America Program at PRBO focused on designing and building long-term bird monitoring programs in the Caribbean and Latin America, and the continuation of training locally-based biologists and citizen scientists to implement these programs.

While many organizations have recognized the need to establish long-term bird monitoring and research efforts in the Americas, the challenge of developing national or international monitoring programs had been difficult because of the lack of qualified biologists or other key resources in many regions. More fundamentally, locally-based organizations that were instrumental to monitoring often had their own goals and locally defined monitoring objectives that made broader, coordinated monitoring very difficult.

The Latin American Program designed a monitoring strategy that allowed locally-based organizations to generate results that would have relevance to local management efforts, while enabling them to participate in wider, regional and international monitoring efforts to help to determine population trends and habitat relationships of both migratory and permanent resident birds at a scale far greater than any single monitoring effort (Latta et al. 2005, Latta 2005). It also allowed them to address basic research questions of the ecology and natural history of migratory and resident bird species.

As an integral part of the monitoring, the Program developed with locally-based partners a series of geographically dispersed avian conservation centers and trained local biologists in standardized avian monitoring and field research techniques. This resulted in designing and presenting training workshops for more than 400 Latin American biologists in field research techniques and the skills needed to interpret and apply monitoring data to conservation planning. The Program also sponsored more than 40 of the most promising international biologists

in internships of three months or longer to help them gain expertise to work independently and establish permanent careers in conservation biology. Many of these students and young professionals have gone on to have distinguished careers in field research and conservation, and have been critically important assets in advancing avian conservation and training the next generation of conservation leaders.

Under guidance and support from the Latin American Program, long-term monitoring programs were set up at strategic locations. In Mexico, a multi-year collaboration among Mexican protected areas, and funding from the Comisión Nacional de Areas Naturales Protegidas resulted in the first nationally-coordinated monitoring efforts in Mexico. Other long-term monitoring programs were initiated with the Latin American Program's collaboration in several areas, including: Coto Brus, Costa Rica (San Vito Bird Club); Quintana Roo, Mexico (ProNatura Península de Yucatán); Cajas National Park, Ecuador (Universidad de Azuay); Guatemala (PROEVAL RAXMU), El Salvador (SalvaNatura); and Sierra de Bahoruco, Dominican Republic.

Latta also pursued important field research, including studies of the conservation of threatened Hispaniolan endemics (Keith et al. 2003, Latta 2005), the importance of regenerating, moist broadleaf forests to birds in the buffer zones of national parks (Latta et al. 2003), and the ecology and evolution of avian malaria (Latta and Ricklefs 2010). With significant grants from the U.S. Fish and Wildlife Service's Neotropical Migratory Bird Conservation Act, the Latin American Program also led a major collaborative effort to evaluate the value of restored riparian habitat to overwintering Neotropical migratory birds in California, Baja California, the delta of the Colorado River, Sierra de Manantlán region, and the Yucatan Peninsula (Latta et al. 2012a,b). Results from these monitoring and research efforts continue to be seen, with the results of long-term studies still being realized (e.g., Tinoco et al. 2009, Latta et al. 2011, Ricklefs et al. 2014, Latta et al. 2017). On-going research and monitoring at some of these sites, for example in Coto Brus, Costa Rica (Latta et al. 2017), Sierra de Bahoruco, Dominican Republic (Latta and Ricklefs 2010, Ricklefs et al. 2014), and Cajas National Park, Ecuador (Tinoco et al. 2009, Latta et al. 2011), represent some of the longest continuous constant-effort mist-netting studies in the Americas and are becoming increasingly valuable for detecting and understanding changes in avian populations.

In addition to research and monitoring efforts, the Latin America Program participated in international conservation forums with BirdLife International, The Nature Conservancy, Conservation International, and other NGOs, and helped to develop bi-national and tri-national conservation efforts through the Sonoran Joint Venture, North American Bird Conservation Initiative, Partners in Flight, and other groups.

The Farallon Islands and beyond.—In April 1968, in cooperation with the U.S. Coast Guard and the U.S. Fish and Wildlife Service (USFWS), PRBO established a permanent, year round research station on Southeast Farallon Island (Figure 20), an effort that continues today. The islands, about 25 miles (40 km) west of San Francisco, are home to over 300,000 breeding seabirds and five species of seals and sea lions. The first recorded notice of the abundance of birds was by the global circumnavigator Drake on 23 July 1579, who Doughty (1974) quoted, as his ship was leaving the vicinity of probably Drake's Bay, that he encountered "Not farre without this harborough did lye certain Ilands (we called them the Ilands of Sant James) having on them plentiful and great store of Seales and birds … we found such prouision as might competently serue our turne for a while." At the present, we also find, 450 years later, a great profusion of seals and birds there to monitor and cherish.

PRBO's initial interest in the Farallon Islands began with a study documenting the migration of landbirds, as a comparison to investigations of migrants using the California coast at Palomarin, and particularly the high number of vagrants for which the islands had become famous (summarized in DeSante and Ainley 1980).

The 1968 establishment of the permanent station on the island began the first, and now the longest running, long-term multispecies study of seabirds and marine mammals in North America (Figure 21). Although landbirds were the original focus of the Farallones, in the first year Ralph landed a contract from California Department of Fish and Game to investigate the effects of human disturbance on Western Gulls (*Larus occidentalis*) (Robert and Ralph 1975). The original biologist, Henry Robert, occupied one of the two Coast Guard houses and the Coast Guard provided transport to and from the island as well. Robert lived nearly full-time on the island for several years, going off only briefly during the winter.

Other work on seabirds on the island was conducted, including the invention of a net (Ralph and Sibley 1970) to catch Cassin's Auklets (*Ptychoramphus aleuticus*) as they plunged down the hill past the buildings, in the very first month of operations. It proved very effective in harvesting one or two hundred auklets each morning as they left after a night ashore. The demography of the Western Gulls was also studied (Coulter 1969). Other work on seabirds included "Operation Seawatch" involving regular counts of birds moving along the coast from shore from a shelter on the cliff overlooking the ocean directly in front of the Palomarin station from 1965 through 1970 (Mans 1969, Ralph 1969). It was revived by Ainley in 1971 on the Farallon Islands and continues to the present.

Figure 20. The usual method of coming ashore on the Farallon Islands, being swung up and over by a winch. Photo courtesy of PRBO.

Many articles and films have been produced about the islands, including Mutual of Omaha's Wild Kingdom "The Remarkable Farallones" (http://losfarallones.blogspot.com/2016/05/the-remarkable-farallones.html).

Massive numbers of seabirds began to wash ashore in 1982 and it soon became apparent that gill nets used indiscriminately by fishermen were responsible (Heneman 1983a,b). Applying science to the impact of the nets on seabirds, PRBO was instrumental in getting the state Fish and Game to restrict use of nets (Heneman 1984) and then end it in 1987 (Salzman 1989).

Landbirds on a seabird island (contributions by Peter Pyle and Jim Tietz).—The rocky islands, lurking on the horizon in view of most of the Point Reyes Peninsula, was always a lure to birders finding eastern vagrants on the mainland. The peninsula itself was a lure to birders (e.g., Paxton 1967) and the islands could only be a spectacular lure. Indeed, Townsend (1885) had shot a Gray Catbird (*Dumetella carolinensis*) there in September 1884, and Dawson (1911) had collected two Black-throated Green Warblers (*Setophaga virens*) in

Figure 21. A PRBO biologist very carefully marking a sea lion in front of the historic residence on the Farallon Islands in 1988. Photo courtesy of B. Boekelheide.

May and September 1911. However, its potential had remained largely untapped for over half a century until the late 1950s. Then, Thoreson (1960), Bowman (1961), and Tenaza (1967) all visited the islands and reported many eastern species.

The first visit of PRBO biologists was in 1967 when Ralph and John Smail visited in early June (7–14) finding some eastern vagrants and mapping the seabird colonies. They banded 1,800 birds, mostly Western Gulls, but also many Cassin's Auklets, and others (Ralph 1985). The defining trip was a week that fall, 20–26 September 1967, when Ralph, Rich Stallcup, and Henry Robert encountered the most spectacular land bird migration 'wave' ever recorded in the Region (Robert et al. 1967). They recorded 118 species, including California's first Great Crested Flycatcher (*Myiarchus crinitus*) (two on 25 September). They found 20 species of warblers, an unpreceded observation (Ralph 1968a), even unusual at eastern U.S. banding stations. Although the migrants concentrated on the two tall Monterey cypresses (*Cupressus macrocarpa*) next to the living quarters and the one prostrate Monterey pine (*Pinus radiata*) nearby, they also could be found along rock walls, in boulder fields, and up at the lighthouse.

Thereafter, the landbirds were regularly monitored year-round with the use of mist nets, water-drip traps, and, most-importantly, a Heligoland trap (Figure 22) built by Ralph, Fred Sibley, Henry Robert, Malcolm Coulter, and Richard Bauer in April 1968 (Sibley 1968). This was a classic trap, over and around the prostrate pine tree. It was made of fish netting and scavenged timbers off the shore. It did yeoman's service until 22 Aug 1991, when it was replaced entirely by mist nets that captured lots of migrants. Banding on the island was never systematic in the true sense, but the counts, supplemented by nets, resulted in what observatories call a 'Daily Estimated Total,' of all the land, shore and water birds on the island (see Pyle and Henderson 1991 and Richardson et al. 2003). This daily count has proven to be very valuable and formed the basis of the efforts to determine arrival patterns with weather (Pyle et al. 1993), and landbird (Pyle et al. 1994a, 1994b), raptor, and waterbird (Pyle and DeSante 1994) population trends on the island and elsewhere. It was always a treat to make the rounds of the island nets, traps, and nooks, in those early years, when one didn't know, and could only suspect, what species would show up next on a rock wall, around the lighthouse, or perched up high in one of the two large cypresses, and in later years amongst the Farallon weed (*Lasthenia*

maritima) which was essentially non-existent until the European hare (*Lepus europaeus*) was eradicated in 1974. By the establishment of permanent year-round bird monitoring on the island in 1968, the island list of species stood at 186 species (Ralph 1968), with 29 of the 31 species of warbler ever recorded in California. Today the list is well over 300 species, with many first records for the state.

During the 1980s–1990s countless hours were spent computerizing data and analyzing the long-term data sets for publication, resulting in dozens of publications mostly authored by Peter Pyle (Figure 23), Dave DeSante, and David Ainley. The landbird data resulted in several important publications on effects of weather and lunar cycle, and trends in migrant bird populations. The bird list on the Farallones was of such great interest that two complete summaries were published in *Western Birds* (Pyle and Henderson 1991, Richardson et al. 2003), following up on DeSante and Ainley's (1980) summary. The biologists also published several identification articles based on their unique ability to study confusing eastern and western species, side-by-side, in the hand and in the field—*Oporornis* warblers, *Spizella* sparrows, *Ammodramus* sparrows, etc. The vagrants were also of great interest. Pyle (pers. comm.) estimates that currently there are a bit more than 40 species for which the first record in California was on the Farallones. Asian highlights recorded were most notable and included the first California records for Northern Wheatear (*Oenanthe oenanthe*), Dusky Warbler (*Phylloscopus fuscatus*), Brown Shrike (*Lanius cristatus*), Red-flanked Bluetail (*Tarsiger cyanurus*), Lanceolated Warbler (*Locustella lanceolata*), Olive-backed Pipit (*Anthus hodgsoni*), and Common Rosefinch (*Carpodacus erythrinus*). Other notable records include an amazing Golden-cheeked Warbler (*Setophaga chrysoparia*) in 1971 (still the only California record), Great Frigatebird (*Fregata minor*) (1 of 2 records), Little Bunting (*Emberiza pusilla*) (2 of 4 records), and Baird's Sparrow (*Centronyx bairdii*) (3 of 7 records).

During this period, the island inhabitants went from an isolated group of biologists (one call to the mainland every two weeks) who were largely independent, to being more connected to the mainland as communications improved. During this period, they developed a close relationship with others of the marine community including fishing party boats, whale-watching boats, and the Coast Guard. They called in the weather every morning to "San Bruno Frank" who would let the fishermen and whale-watchers know if they should try for a run or not.

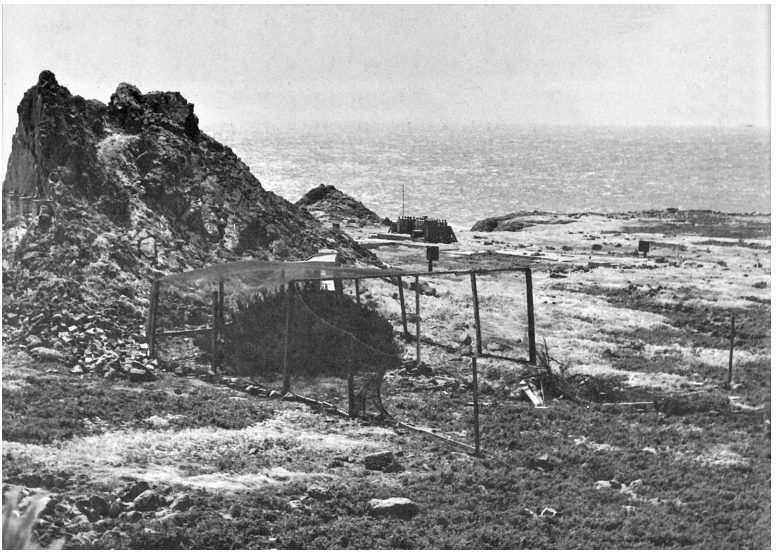

Figure 22. The Heligoland Trap built in 1968 over and around the prostrate tree on the Farallon Islands that captured many landbirds, both rare and exceedingly common. Photo courtesy of PRBO.

The fishermen were so grateful for this that, as the biologists reported, "they would load us up with fresh fish and also fresh Dungeness crab for each Thanksgiving." Island biologists helped the Coast Guard with many search-and-rescue operations, including saving a fisherman's life whose boat flipped at the dangerous tip of West End in the middle of shark season. They also assisted the USFWS with many improvements to island systems, including the demolition of decaying buildings and other structures, the saving and repair of the Coast Guard House, and the installation of solar-energy-collection and water-collection systems which enabled their independence from Coast Guard deliveries of fuel and water. Most of this work occurred in fall during the landbird/shark season, so as not to disturb breeding seabirds.

During the mid-2000s, landbird migration surveys were standardized in the fall to provide some basis for effort and to supplement the incidental sightings that had been the basis of the Daily Estimated Totals. For landbirds, morning and afternoon area searches were initiated in 2005 that required one or two observers to count all

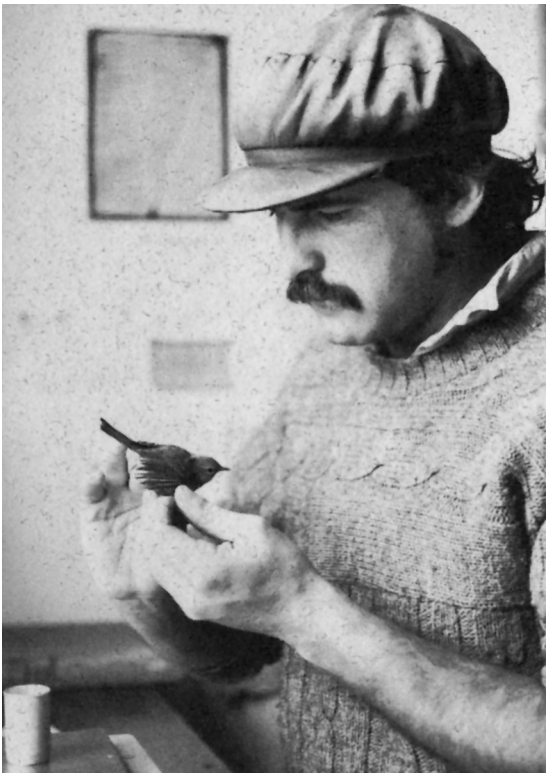

Figure 23. Peter Pyle, long term Farallon Biologist and author of 'Pyle Guide' and numerous publications on landbirds, seabirds, and sharks. Photo courtesy of PRBO.

birds in five different areas around the island. To increase their ability to track individuals during their stopover and to improve their Daily Estimated Total accuracy, biologists began color-banding the six most abundant migrant songbirds (Townsend's Warbler [*Setophaga townsendi*], Yellow Warbler, Yellow-rumped Warbler [*Setophaga coronata*], Golden-crowned Sparrow, White-crowned Sparrow, and Dark-eyed Junco [*Junco hyemalis*]). A morning survey for migratory seabirds was initiated in 1985 that entails sitting on the front steps of the biologists' quarters with a 30x scope fixed on a single point on the

horizon for five minutes and afternoon fall seabird migration surveys began in 2005 and were standardized to six 5-minute surveys.

High-tide shorebird counts around the roost sites of the island were initiated in the 1980s and a standardized gull survey was initiated that entailed counting all migratory gulls from East Landing to North Landing. This survey showed a 10-fold increase in California Gulls (*Larus californicus*) during the late 2000s before it crashed back to previous numbers during the 2010s. The Farallones are also home to the non-native house mouse (*Mus musculus*), at an estimated 500 mice per acre, "one of the most dense infestations of rodents anywhere in the world," according to one expert. This proliferation fed a growing population of Burrowing Owls, and in 2007, biologists began intensively banding and monitoring them to collect baseline data of stopover duration and overwintering behavior prior to the mouse eradication planned by the USFWS (Mills et al 2002). Owls were captured in mist nets at night by broadcasting Burrowing Owl territorial calls, and then they were marked with field-readable bands. During the day, a dedicated owl researcher would examine every known roost hole on the island to see if one was standing outside the entrance. These roost surveys dramatically increased our estimates for the number of owls arriving seasonally and their impact as they fed on breeding storm petrels (Sydeman et al. 1998) when mouse populations were low. They discovered that a small percentage of owls successfully overwinter and return in subsequent years including an owl that was originally banded in Idaho. Plans to eradicate the house mouse, a predator itself of petrel eggs (Nur et al. 2012), is still in the planning stage after many years of delay by government entities (Mills et al. 2002).

MARINE PROGRAMS

The Seabirds on the Farallon Islands (contributions by David Ainley and Russ Bradley).—It was in 1971, with the arrival of a volunteer, David Ainley (Figure 24), that a formal marine program was initiated along with the resident biologist, Jim Lewis (present since 1970 and staying on the island until 1977). A notable seabird experience at Southeast Farallon was working on the Chevron oil tanker spill that occurred in the Golden Gate in January 1971, oiling most members of the small, remnant Common Murre (*Uria aalge*) population that bred on the islands. This incident and subsequent oil spills and that impacted

bird populations became an integral function of PRBO over the years and continues today with Point Blue being a major player in California oil spill response in identification and documentation of bird species impacted.

An important research program was designed to compare the life histories, population trends, breeding success and diet of the 11 seabird species that bred on the Farallones. The thought was that a comparative study would better reveal how members of this seabird community, with components having different life history strategies, coped with oceanographic and food web variability well known for the California Current. Whereby, some species would do well, while others faltered in any given year, a strategy not documented among seabird studies at the time, which were mostly directed at single species. This work resulted in the publication of Ainley and Boekelheide (1990) *Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of an Upwelling System Community*, a seminal publication on seabirds as interacting with marine environments, as well as many other publications.

The research effort on the islands became year-round owing to extended and asynchronous aspects of various species' annual cycles. When the Coast Guard automated the lighthouse and then removed its personnel in December 1972, PRBO was left on its own. It was incumbent upon the organization to essentially double its budget. The Dean Witter Foundation grant of $15,000 in late 1971, with matching grants from the S. H. Cowell Fund, the Lurline B. Roth Charity foundations, and many members, insured that PRBO staff ornithologists would remain on the island for the foreseeable future. Later, Board Member Jim Tasley, with contacts in the Department of the Interior, wrangled a long-term contract from the USFWS for PRBO to become the custodian of the Farallon National Wildlife Refuge. That became the first time that Ainley was paid, having since gained renewed grants from the National Science Foundation to continue seasonal research on penguins and skuas in Antarctica.

In order to replace the logistical support of the Coast Guard, as the USFWS contract began, the San Francisco chapter of the Oceanic Society's "Farallon Patrol" became greatly interested in offering help. This resulted in volunteer boat owners, organized by Charlie Merrill and Bob Botley, supplying transportation to and from the mainland for Farallon personnel and their equipment and food. That effort, which involved weekly to monthly trips across the 25 miles each way from

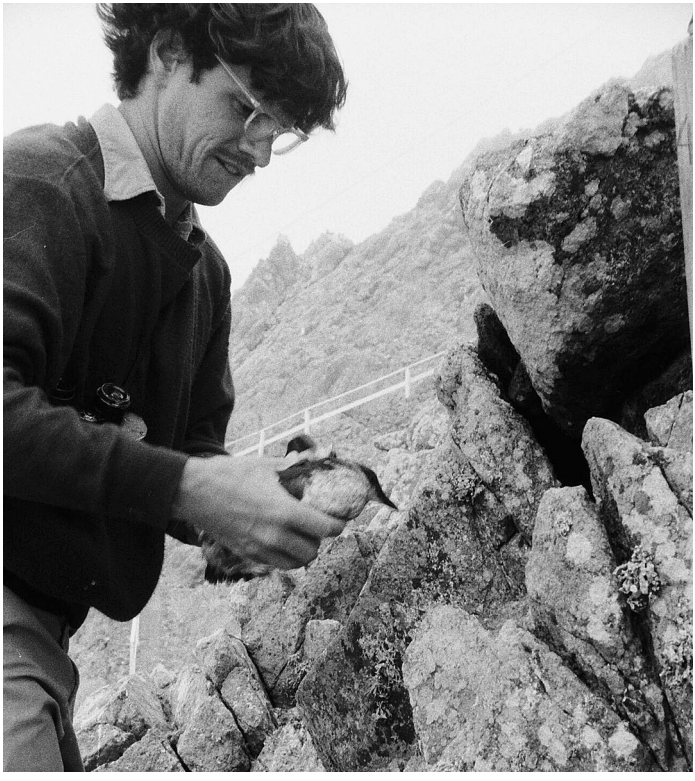

Figure 24. David Ainley, the extremely prolific leader of PRBO's seabird research for many years on the Farallon Islands, the eastern Pacific, and Antarctica, holding a Common Murre in 1982. Photo courtesy C. Peaslee.

San Francisco Bay to the Farallones, helped immensely to maintain the year-round presence of biologists on the island, and has continued to this day.

During the early 1970s, as the marine research was being instituted, PRBO established protocols to better protect the island fauna from disturbance, including the removal of feral cats and European hares and restricting access to many areas during breeding seasons. The USFWS subsequently formally adopted the conservation protocols formulated by PRBO. The result was the eventual re-establishment of

two species of pinnipeds (elephant seals, northern fur seals) and two bird species (Rhinoceros Auklet [*Cerorhinca monocerata*], Black Oystercatcher [*Haematopus bachmani*]), not present on the island for a century or more, as well as dramatic, still ongoing, and increasing populations in many of the other seabird species. For instance, the number of breeding murres increased from about 6,000 pairs in 1971 to about 280,000 pairs by the second decade of the 2000s. Overall, the islands are host to more than a quarter of a million seabirds of at least 12 species, including, according to recent estimates, a few thousand each of Ashy Storm-Petrels (*Oceanodroma homochroa*) (possibly half the global population) and Leach's Storm-Petrels (*O. leucorhoa*). The magnitude of the northern fur seal recovery is astounding, the first pup was born in 1996, but by 2016 biologists estimated over 1,100 pups and over 2,200 total animals at maximum count. This is an extraordinary exponential population increase and premier example of population recovery. This recovery was likely unthinkable by early Farallon biologists, in part given that many thought the fur seals wiped out by sealers in the 1700s could well have been Guadalupe fur seals (an endangered species). Continued recovery of this fur seal population may have large impacts on the island's ecosystems.

Taking advantage of opportunity, early on the PRBO Marine Program began to monitor and investigate the five species of pinnipeds that compete with the seabirds for space. In addition, studies began on the apex predator in the system, the great white shark, that helped to control the pinniped populations. In the late 1990s, PRBO co-hosted an international symposium on the shark that soon after became listed as a protected species within California jurisdiction. By the mid-1980s, taking advantage of a National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service effort to monitor fish populations in central California waters, PRBO also began to conduct seabird surveys on a regular grid of trawl stations, thus to learn more about the at-sea distribution and abundance of Farallon seabird breeding species. That effort tied in with the investigation of seabird diets on-going at the Farallones, and is still continuing (Ainley et al. 2018, Wells et al. 2017).

All of this research in the highly productive waters of the California Current was eventually fairly well funded by private donations (2–3 fulltime biologists, with volunteers). At intervals during this time, Ainley was continuing to conduct research in the Antarctic

funded by the National Science Foundation (NSF) (Ainley et al. 1986, Fraser and Ainley 1986, Ainley et al. 1995, Ainley et al. 1998). This research had, like that at the Farallones, branched from land-based studies of breeding seabirds to investigations of their at-sea ecology, especially with the arrival of biologist Larry Spear at PRBO. A further development, also funded by NSF, compared the at-sea ecology of Antarctic seabirds with that of seabirds in the eastern Tropical Pacific; again, the comparative approach to better understand processes of one system compared to the other (Spear et al. 1998, Spear and Ainley 2007, Spear et al. 2007). The Tropical Pacific effort piggy-backed on the ships involved in NOAA's Eastern Pacific Ocean Climate Study that was geared to better understand and predict El Niño, a climate phenomenon that is very much a major factor in the vagaries of Farallon marine birds and mammals. This effort continued from 1985 to 1994.

While the at-sea research of PRBO in the Southern Ocean was discontinued in the early 1990s, a long-term effort overseen by Ainley was begun in 1996, to understand the demography of Adélie Penguins (*Pygoscelis adeliae*) in the Ross Sea. Ainley had received NSF grants to study penguins and skuas in the same localities during 1973–1974 and 1980–1984. The penguin population was increasing, and the annual effort was undertaken, funded by NSF, to find out the demographic and ecological processes that could explain the trend (Ballard et al. 2001, Ainley et al. 2004) The research continues today with the Point Blue contingent led by Grant Ballard (Figure 14) with an emphasis on impacts of climate and environmental change (Ballard et al. 2010a,b, Ballard et al. 2012, Dugger et al. 2014).

Sharks and sea mammals (contributions by Peter Pyle).—Notable research on sea mammals and the charismatic white shark (*Carcharodon carcharias*) program had its heyday on the island in 1987–2004. The shark research was a high-profile project that brought with it both excitement and challenges, the latter not so much with the sharks as with humans who are attracted to sharks. The primary white shark team consisted of Peter Pyle, Scot Anderson, David Ainley, Phil Henderson, and Peter Klimley. Successes for the program include: (1) new information on the natural history of white sharks in their natural environment, including their predator-prey relationships with elephant seals; (2) publications of over 20 scientific manuscripts and at least 50 scientific presentations on biology of sharks; (3) several successful TV

documentaries on the shark program; (4) information gathered to change public perception of white sharks, from evil predators to important components of a healthy marine ecosystem; (5) spearheading of a California State bill to protect white sharks from trophy hunters, which passed the state legislature in 1994; (6) documentation of the predation of white sharks by orcas in 1997 and again in 2000; (7) worked with Stanford's Hopkins Marine Station on a program, applying many pop-up satellite tags to sharks at the Farallones, resulting in a paper in Nature (Boustany et al. 2002); and (8) wrote legislation to regulate the activities of cage divers going to the Farallones to view white sharks, including banning the use of chemical, blood, or animal-part attractants, limiting the use of decoys, and requiring that all cage-diving operations have an educational component for their customers on the importance of white sharks to the ecosystem. Sea mammal publications include occurrence patterns of cetaceans around the island, the first record of a Guadalupe fur seal in northern California (1986), and on the re-colonization of the Farallones by northern fur seals in 1996.

The Current Farallon Program (contributions by Russ Bradley).—In the late 1990s, under the leadership of Bill Sydeman, PRBO's Farallon program expanded in placing its long-term marine datasets into more of an ecosystem context. USFWS Refuge Manager Joelle Buffa's near decade-long tenure in the late 1990s and early 2000s vastly improved island facilities, including renovations to the houses, modernizing the island's water collection and septic systems, and switching to solar as a primary power source. The early 2000s saw a huge increase in some seabird populations, particularly Common Murres, which reached their highest numbers since commercial egging during the mid-1800s. Unique climatic events and seabird responses marked the 2000s, suggesting that Farallon seabirds are now responding to ocean climate differently than they had in the past. The early 2000s also marked the arrival of Pete Warzybok and Russ Bradley (Figure 25), who have led the seabird program since then. Around 2006, research began expanding to broader terrestrial ecosystem studies, in addition to the long-term work on seabirds, pinnipeds, landbirds, and white sharks. New studies examining island Burrowing Owls, salamanders, insects, and vegetation were initiated. In recent years, Point Blue and the Farallon Refuge (led by Russ Bradley and Gerry McChesney) have

worked to increase island safety, further facilities enhancement, include the island's waters in state marine protected areas, and expand our understanding of how wildlife on the islands interact with the ocean through tracking studies. By 2016, over 1000 interns and students have been trained in ecological field studies on the Farallones.

Point Blue looks forward to a long future on the Farallones, building on a legacy of 48 years of continuous research and stewardship.

WETLAND AND WADERS PROGRAMS
(Contributions by Lynne Stenzel)

The Point Reyes peninsula and surrounding areas are known for their abundance of mudflats, marshes, and other wetlands that have long attracted birds and birders. Concentrating the effort of PRBO on those areas was a natural starting point for the fledgling observatory. Coupled with the interest from agencies such as the California Department of Fish and Game and the National Park Service, a firm foundation of monitoring and research in Bolinas Lagoon, Tomales Bay, Limantour Estero, and Drake's Bay was established.

Within the first year of their operation, PRBO secured a grant from the Park Service and later from the California Department of Fish and Game to conduct and continue a study of the Limantour Estero's avian resources, supported by the Seashore's Superintendents Les Arnberger and Edward Kurtz (Lenna and Ralph 1967a,b). This involved aerial and land-based censuses by biologists John Smail and Phil Lenna. This work included night time mist netting to mark shorebirds, accomplished by volunteers processing birds through the night around a campfire that was often celebratory in nature (Jenkins 1967). A detailed study of dowitchers was conducted by Lenna (1969). In 1969 the data on key shorebird feeding areas in the Limantour Estero contributed to the National Park Service amending their master plan to ensure that Limantour would remain a natural area.

The waterbird program really got underway when Gary Page (Figure 9) was hired to develop a shorebird research program in 1971. He launched an ecological study of the nearest estuary, Bolinas Lagoon, focused on shorebirds, but soon expanded to include: surveys of all waterbirds on this wetland and elsewhere in the Point Reyes area with Bob Stewart, Phil Henderson, and Dave Shuford; the raptor community

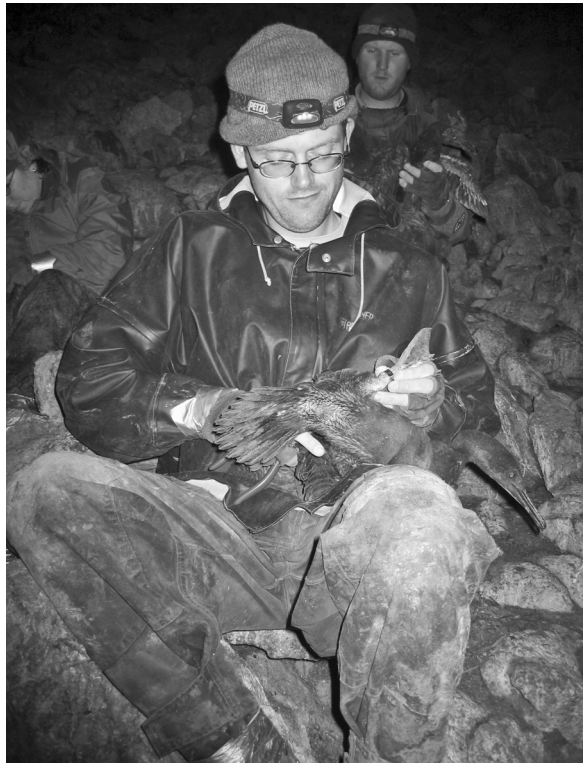

Figure 25. Long-term Farallon Biologist and Program Director, Russ Bradley, banding a cormorant. Pete Warzybok is in the background. Photo courtesy of L. Arata.

around the lagoon and its impact on shorebird populations with Dave Whitacre; invertebrate sampling for the mud-dwelling prey of shorebirds with Lynne Stenzel (Figure 9) and Harriet Huber; and for small sandpipers, age and sex composition, molt, and dispersal of color-marked individuals. He pioneered the use of samples from shorebirds for diet studies that did not involve sacrificing the birds: he used regurgitated pellets, stomach-pumped samples, and fecal samples. Many volunteers and other staff assisted with waterbird surveys and on

banding expeditions of the study. Aspects of the raptor predation, and home range and dispersal on the lagoon continued with Barbara Kus, Phil Ashman, and Nils Warnock.

Snowy Plovers became an early focus when in 1976 Page was looking for something to more fully occupy his summer. He started exploring the small numbers of Snowy Plovers that bred in the Point Reyes area and began what was to become a major study of the bird. The species was on a special National Audubon Society "Blue List" of species believed to be experiencing serious population declines, but in fact, very little was known about the species. With the active help of John and Ricky Warriner, who lived near Monterey Bay, the study was expanded to the Pajaro River near Santa Cruz in 1977, and this comprehensive work continues to this day. The work has included the discovery of the plovers' serially polygamous nesting system, breeding surveys, and population-size estimation of the coastal-breeders as well as interior Western North America breeders. This resulted in the petition to list the Snowy Plover under the Endangered Species Act.

The effects of the oil spills program had its genesis in the late 1970s, when Gary Page and David Ainley embarked on a collaborative effort with Dave Shuford, Lynne Stenzel, Jules Evens and others to model the effect on nearshore and estuarine birds, should another oil spill occur similar to the Chevron spill in 1971 in the Gulf of the Farallones. When the oil tanker *Puerto Rican* exploded and sank outside the mouth of the Golden Gate in 1984 (PRBO Staff 1984), Page, Ainley, Sarah Allen, and Bob Boekelheide led the effort to document the effects on marine and wetland bird and mammal populations in the area. Then, two years later, Page and Harry Carter surveyed beached carcasses and looked at carcass turnover after a relatively small oil spill continuously emanating from the *Apex Houston* as it traveled south from the Golden Gate to Monterey County. They estimated the spill claimed almost 10,000 marine birds. The settlement from the court case eventually funded local beached bird programs and the restoration and establishment of a new murre colony near Devil's Slide in San Mateo County, presently in its 20th year.

Early in 1980, Marin Audubon members discovered Black Rails in marsh habitat near an impending development on the Corte Madera shoreline on San Francisco Bay and asked Page and Jules Evens to study the populations there. That study led to more studies of rails in the

San Francisco Bay estuary, which became Point Blue's first investigations into the Black and Ridgway's rails' distribution and abundance. Rich Stallcup was also a major contributor to this work.

In 1988, Shuford, Stenzel, Nils Warnock, and Sarah Griffin, led by Page, embarked on the first comprehensive spring survey of shorebirds on the San Francisco Bay estuary, a two-day event (north and south bays) using over 100 volunteer observers each day, followed by an aerial census the following day. This became the first survey of a range-wide effort, soon christened the Pacific Flyway Project, to document the abundance of shorebirds from "BC to BC" (British Columbia to Baja California) once each spring and fall (usually before the spring or after the autumn passage through most of their Alaskan coastal stopover locations), and also in the winter, the latter season only in the Central Valley. The survey extended as far east as the Rocky Mountains and was powered largely by the efforts of volunteers and partners who joined us in the field each season and contributed their data to the cause. Janet Kjelmyr joined the team in Fall 1988, and the project continued with Page, Stenzel, Shuford, and Kjelmyr through 1995. It provided far more complete information on shorebird abundance and distribution in western North American than had previously been available.

These results identified and highlighted the importance of many wetlands for shorebirds and demonstrated the important role of agricultural lands during winter and migration periods for shorebirds in the western U.S. (e.g., Page et al. 1997, 1999, Shuford et al. 1998, 2002, Stenzel et al. 2002, Stralberg et al. 2011a). The survey results contributed to important international designations for some western wetlands as Ramsar Wetlands of International Importance and as Western Hemisphere Shorebird Reserve Network sites of regional, international, and hemispheric importance (e.g., Bolinas Lagoon, Tomales Bay, Grassland Ecological Area, San Francisco Bay estuary). Many of project's partners continued to collect data long beyond that period, which has helped to inform Point Blue's more recent, and far more expansive and collaborative, Pacific Flyway Shorebird Survey and Migratory Shorebird Project—projects aimed at long-term population monitoring and research for conservation under Matt Reiter and Catherine Hickey (http://www.migratoryshorebirdproject.org).

About this time, 1988–1990, Page and Steve Emslie cooperated in a project comparing Double-crested Cormorant reproductive success on the Farallones with a colony nesting on the Richmond-San Rafael

Bridge, where individuals were feeding near an industrial outfall on the Bay. They demonstrated the important role human structures perform in supporting nesting seabirds within the San Francisco Bay estuary (Stenzel et al. 1995). In 1967, an important study began on the nesting egrets and herons at Audubon Canyon Ranch on Bolinas Lagoon by Helen Pratt, a dedicated observer with the help of PRBO personnel (Pratt 1968). This long-term study, by a very talented amateur in the tradition of many ornithologists of past years, has contributed much to our knowledge of wading bird nesting chronology and success, and predation. For example, see Pratt (1972, 1974) and Pratt and Winkler (1985).

EDUCATION AND OUTREACH PROGRAMS
(Contributions by Melissa Pitkin)

Since the organization's inception, outreach and education have always been a key component of Point Blue's mission. A periodic, high quality newsletter kept the public and PRBO members informed, putting out new and important information about the studies of birds, their habitats, and the value of science for on-the-ground conservation and climate-change adaptation. This newsletter was originally called the "Point Reyes Bird Observatory Newsletter" and the first was dated July 1965 (edited by Robert O. Paxton). Almost 190 issues have been published by 2018, and they contain many detailed and entertaining accounts over the more than 50 years, many edited by Claire Peaslee (Figure 26). This primary source, if fully mined, would have made our account much longer, and perhaps more fulsome than it is. The newsletter has been variously named, including "The Observer" and "Point Blue Quarterly." All the issues of the newsletter will be scanned and made available on the Point Blue website. In the present account, we perused the hundreds of articles in all the numbers and referenced a few. Most of the interesting information in these articles made its way into the scientific literature, so we don't usually reference many of these later articles in this account.

Some special issues have seen very wide circulation. In 1981, a special California Condor Issue (Newsletter 53) explored the controversy surrounding taking the last condors into captivity. Many strong voices in the observatory and among scientists advocated letting

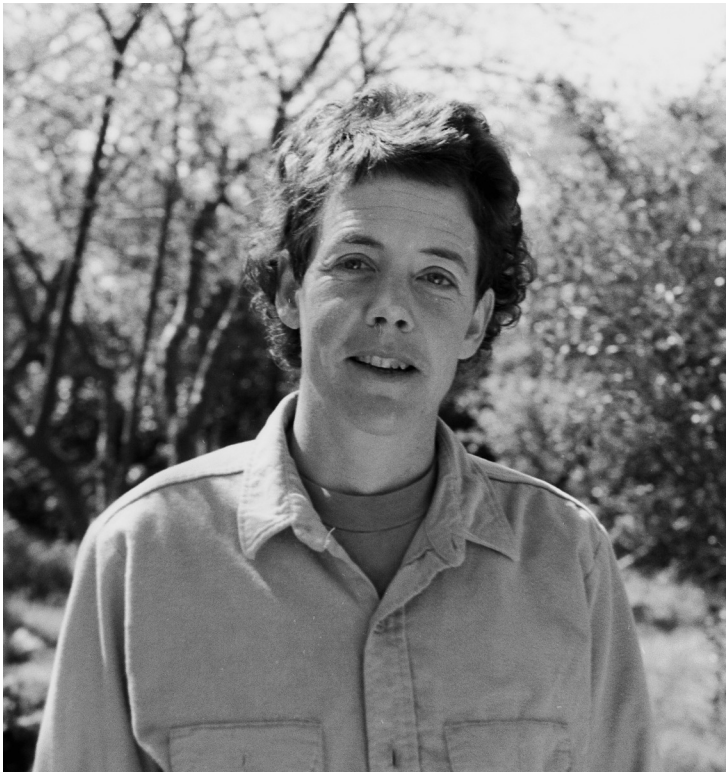

Figure 26. PRBO biologist and writer, Claire Peaslee, the incomparable editor of the PRBO newsletters and many communications. 1989 photo courtesy of PRBO.

the bird go gently into extinction. Many did not, and they prevailed, so that the condor may be a success story someday.

Many forms of support came to the observatory, and one of the most lasting for the outreach was art by Keith Hansen whose fantastic representations of birds and birding graced many a calendar and newsletter over the years.

Always key to a research institution is the library. PRBO's Stephen Gregory (of Winnetka Illinois) Library was established in 1966 with complete bound copies of many journals, partly funded by Lillian Henningson. Since then it has expanded to many shelves of reports,

journals and other information that even in today's digital world is often consulted.

On the education front, legions of student groups from preschool to advanced University graduate programs and Elderhostel have visited to see 'science in action' in the form of mist-netting and banding of landbirds. Birds in the hand remain a powerful educational tool that can inspire youth to pursue scientific careers and convince adults to conserve the natural world. Stewart (1985) summarized many of these outreach efforts, including trips to near and far flung places (see Natural Excursions program, below).

In the first several decades, banding demonstrations were always an important and regular part of the fledgling observatory, especially considering how few schools are within any sort of traveling range of the Palomarin station in sparsely-populated West Marin. The area is still quite rural as zoning restrictions have kept development to an amazing minimum, and the area seems to have barely changed at all to a visitor returning after 50 years away. Many Bay Area schools and community groups, and a few from farther afield, visited the field station for banding demonstrations. In the 1980s and 1990s under direction of Bob Yutzy, Stephanie Kaza, John Kelly and Linda Parker, the program expanded and included programs conducted in the classrooms before the students visited the station, and field trips lead by scientific staff both near and far. The program that was termed "Natural Excursions" featured trips led by staff all over the world and proved highly successful in recruiting new members and donors that have financially supported Point Blue for decades.

One of the organization's inspirational founders, Rich Stallcup (Figure 27), a true master of natural history and spokesperson for conservation continued teaching birders, Point Blue members and supporters, students, and citizen scientists for his entire life (Evens 2013). His "Focus" columns (originally published in the Newsletter) continue to be relevant and reprinted in each current Quarterly.

In 1997, Melissa Pitkin (Figure 28), recently graduated from University of California at Davis, was hired to meet the community education need with the banding program. Working with David Cothran, who had been conducting bird walks and public demonstrations at the Palomarin Station, and with the mentorship and support of Geupel, Melissa's passion for connecting people to science sparked what is now the organization's Education and Outreach Group.

Figure 27. Rich Stallcup, one of the founding members of PRBO, raconteur, and naturalist par excellence, on an offshore pelagic trip in 1981. Photo courtesy of C. Peaslee.

Figure 28. Melissa Pitkin, in 2015, who first visited the Palomarin Field Station as a 3rd grader has lead Point Blue's Education and Outreach Group for over 20 years. Photo courtesy of L. Arata.

From 1997–2003, the program tripled the number of people who participated in banding demonstrations, added a classroom education program for San Francisco schools, developed pre- and post-curricula for visiting classes, initiated a more robust bird walk program with the help of Rich Stallcup, and began engaging in community outreach through local newsletters and events. The Visitor's Center at Palomarin was remodeled in 2002 to more accurately convey the scope of PRBO Conservation Science. The guidebook *Mist Netting with the Public* was published (Pitkin 2006) for field stations on how to effectively include community groups in mist-netting demonstrations. This guidebook was the product of her Master's in Science Education and drew from her experience building observatory education programs at Palomarin and at the Klamath Bird Observatory in Oregon.

One of the successful outreach programs was the Point Reyes Audubon Christmas Bird Counts. Originally there were two, the Drake's Bay and Tomales Bay counts that were merged in 1970 by Jon Winter into the Point Reyes Peninsula count. By 1980 it had reached over 200 species, consistently in the top ten counts in nation, and at or near the top in participants, at about 250.

Today, Point Blue's Education and Outreach Group links the scientists with communities and stakeholders primarily through the Training the Next Generation Initiative. The focus of the initiative is to provide real-world experience and training for future scientists, conservationists, and educators, by equipping them with the passion, knowledge, tools, relationships and skills necessary to address climate change and other environmental threats in their careers. To achieve this, the Education and Outreach group leads school programs including the community-based habitat restoration program known as STRAW (Students and Teachers Restoring A Watershed), coordinates intern-training curricula, provides communications training for Point Blue's science staff, and coordinates the organization's print and online communications and media outreach.

Outreach plays a valuable role in fundraising. Travel to locations that are bird-rich or tell the story of our science impacts, continue to provide invaluable connections between staff, board members and donors. Being 'in the field' remains the best forum to educate anyone about birds, natural history, ecology, and conservation.

INFORMATICS PROGRAMS

Long-term monitoring remains a core value and strength of the organization and has proved to be extremely important in this time of accelerated change as well as help provide important context to the majority of ecological research projects that are only funded for few years. Short-term projects also provide important opportunities to integrate with partners and fund long-term conservation objectives. To describe, enter, manage and allow access to data collected by hundreds of biologists over decades is not to be underestimated. Accordingly, Point Blue invested heavily in informatics over the last decade and currently maintains over one billion observation records as part of the Avian Knowledge Network (AKN) http://www.avianknowledge.net/). Point Blue manages 18 data sets that are at least over 10 years old (Warnock et al. 2004), and provides web-based access to data for researchers and applications to decision makers as part of the California Avian Data (http://data.prbo.org/cadc2/) (a regional node of the AKN).

In the early 2000s with help from board member Jim Quinn and University of California, Davis Information Center for the Environment (ICE), Point Blue made the realization that they were in the information business. Point Blue had more data and information than was being utilized in its scientific publications and it desperately needed to be 'mined and day-lighted' to have bigger impacts on conservation outcomes. Thus, Point Blue launched its Informatics program to begin to open source this information (Ballard 2006). One of the key strategies was the development and hosting of the Avian Knowledge Network (AKN: http://www.avianknowledge.net/) with Cornell Lab of Ornithology (Kelling et al. 2009). The AKN is now an unprecedented collation of people, institutions, and government agencies providing current, on-line data and information and on birds and habitats. It follows best data management practices described by Martin and Ballard (2010). It allows users to ask conservation questions about populations at scales that were never possible before. Having current and quantitative information at our fingertips will be crucial to making effective conservation decisions in a rapidly changing world.

THE FUTURE

Current and future directions.—Marin County, the San Francisco Bay Area, and surrounding areas have a long history of iconic birders, field ornithologists, and biologists, many of whom have played a role in the operations and success of the organization. Similarly, Point Blue has influenced the career and development of these biologists.

The Bay Area serves as an economic, environmental, and innovation world hub, incubating such things as the environmental movement (e.g., Sierra Club, Isaac Walton League), personal computers (Apple, HP, Google, and Oracle) and the new shared economy (Uber, Lyft, and Airbnb). The combination of these things helps to bring in the private dollars (both from individuals and family foundations) needed to sustain conservation projects over the cycles of government funding. Indeed, Point Blue is indebted to the many generous contributors over the last five decades that have allowed it to flourish and meet the environmental challenges of a changing planet. For most current projects, every federal dollar raised is matched by private contributions. This 'value-added' is helpful for many programs, and even vital for some.

Support.—While private support has always been critical to Point Blue, declining federal and state budgets has most NGOs targeting fundraising in the private sector. However, it is important that some portion, probably around 25–40%, remain with government contracts to ensure that close partnership remain between NGOs and major government agencies with resource missions. This will ensure the best available science and new information in guiding mandated agency planning and management despite political change and highly variable federal and state budgets. It also ensures agencies will be getting the most value out of their limited and decreasing dollars spent on natural resources and adaptive management.

The role of an NGO in natural resources conservation is a sustained partnership. Through long-term contracts (e.g., the USFWS and Point Blue have had a Memorandum of Understanding to protect and do research on the Farallon Islands for over 40 years), long-term staff, and the collaborative connections made with other researchers including interns and former staff who have gone on to work in the public sector, Point Blue now has numerous direct links to land managers and

decision makers. In fact, many of Point Blue's monitoring projects and programs have outlasted their staff, as well as the government staff who started them. This long-term, place-based knowledge is crucial to making informed decisions in a rapidly changing world.

Place-based projects.—Starting with Ryan Burnett's (Figure 15) full-time presence in the Sierra Nevada (in Chester, California) it became apparent that Point Blue could greatly improve its influence and recognition by maintaining a full-time year-round presence in a community. Not only does it build trust with local public and private land owners and managers, it allows Point Blue to be a biological resource and active participant in the community. Thus in 2010, Point Blue switched from ecosystem 'Divisions" (Terrestrial, Marine, Wetlands) to place-based 'Groups' (California Current, Central Valley,

Figure 29. Point Blue's Rangeland Watershed Initiative Director Wendell Gilgert with his beloved 'Sharpshooter Shovel' in 2018, explains how cattle can be managed for conservation benefits. Photo courtesy of G. Geupel.

Pacific Coast, San Francisco Bay, and Sierra Nevada) to unify staff across ecosystems and foster place-based knowledge.

In the 2011 with the addition of Wendell Gilgert (Figure 29) at Point Blue with a 30-year career as a biologist at the Natural Resource Conservation Service (NRCS), Point Blue launched a major new initiative that focuses on conservation of rangeland and the ecosystem services they provide (water, carbon, and biodiversity). The key strategy of this initiative is to partner with NRCS and put 14 'partner biologists' in local NRCS offices throughout the Great Valley, as well as northeastern and coastal California (Gilgert 2011). These partner biologists strive to be integral members of the community, help put farm bill dollars on the ground in the form of conservation practices and perhaps most importantly monitor the effectiveness of these efforts. A key component of the initiative is the Rangeland Monitoring Network with a highly standardized protocol and handbook for use by others (Porzig et al. 2018). This program collects standardized data on soil, vegetation, and bird biodiversity and is instrumental in measuring the effectiveness of conservation practices prescribed and changes in grazing regimes (e.g., Heneman et al. 2014). In 7 years, these partner biologists have engaged over 900 producers and 12 different land trusts to implement conservation parties on over 700,000 acres (283,000 ha) of rangeland, including over 150,000 acres (60,000 ha) in prescribed grazing management. This conservation work has involved prescribing 43 different NRCS conservation practices, from fencing for prescribed grazing systems to riparian plantings for improved wildlife habitat. Focal species bird monitoring conducted by these biologists is helping to prescribe practices and evaluate their effectiveness in an adaptive management framework (Geupel and Eyestone 2015).

Climate-smart initiatives.—As noted above, the marine program had an integrated ecosystem approach to data collection since its inception. With Point Blue's move to place-based groups it became more apparent that land-based communities also needed a more integrated ecosystem approach to implement conservation. Staff were being asked to engage in resource planning that could best be based on historic populations or conditions. Point Blue's long-term data sets were now being used to predict future occurrences of not just birds but future habitat and places where climatic change would be severe ('hot spots') or serve as refugia ('cold-spots') (Wiens et al. 2011). Under Sam

Veloz's leadership and modeling skills, Point Blue now has active climate change focus (e.g., Veloz et al 2013).

This change in focus while still relying on Point Blue's core values-scientific integrity, long-term data sets, and partnerships led to a name change and more importantly and new 5-year strategic plan that focused on climate-smart outcomes. Point Blue defines its climate-smart approach by using the following guidelines: (adapted from Stein et al. 2014) (1) Focus goals on future conditions; (2) Design actions in ecosystem context; (3) Employ adaptive and flexible approaches; (4) Prioritize actions; (5) Collaborate and communicate across sectors; and (6) Practice the ten percent rule: spend 10% of your time on new innovations and experiments. The organization, as part of its current 5-year strategic plan, has focused on the following six cross group initiatives each with specific measurable outcomes: (1) securing water and wildlife on working lands; (2) protecting our shorelines; (3) conserving ocean food webs; (4) catalyzing climate-smart restoration; (5) make natural resource plans and policies climate-smart; and (5) training the next generation. (For more information, see http://www.pointblue.org/priorities/our-approach/).

Strength of this organization today.—There are many factors that that we think are essential and that give the authors hope for the future of the organization. In recent strategic planning sessions, Point Blue staff, board, and leadership aligned on five differentiating or distinctive capabilities or 'superpowers' that are truly unique and important to our success.

These include:

1. Applied Conservation Science: we do science that is mission-driven and we do it in a rigorous way that our partners value. It is science that will be used to achieve our vision.

2. High Performance Partnering: we bring scientific expertise, follow-through, facilitation, positive attitude, active listening skills, and more. We are highly valued for this and we do it well.

3. High Quality Data and Data Management Skills: we "awaken" the data; it is relevant to real life problems; we manage it so it is safe and accessible, and we distill science for decision-making for and with partners.

4. Empowering and Inspiring: we effectively use a variety of means to provide knowledge and skills needed for climate-smart conservation. We teach and learn from others.

5. Long Term View (past and future): we use our data and others' data in the context of ecological and evolutionary time to better understand current environmental conditions and environmental change and hence make strong conservation recommendations.

Communities of both human and wildlife, and the systems they need to thrive, are under an increasing number of threats in a rapidly changing world (Ripple et al. 2017). Excessive rainfall, fires, and drought have caused unprecedented impacts on communities throughout North America and the globe. For life on earth to continue to thrive under this rapid change, we urgently need to test novel nature-based and multi-benefit solutions and adapt accordingly. This requires rigorous and quantitative monitoring programs that allow us to evaluate when and where conservation actions are working and 'course correct' if not. We must also allow scientists and resource managers the time to innovate and experiment ('the 10% rule' whereby a small fraction of one's time and budget can be spent on "hobby" research, opening new avenues of investigation), be proactive in their approaches and above all share extensively what they are learning.

Organizations such as Point Blue that are based in applied science, long-term view, and extensive collaborations can be a model of how to practice conservation. Well respected organizations that are data driven, engage in on-the-ground planning and implementation, build trust with a diversity of stakeholders, and, perhaps most importantly, educate and become educated by everyone with whom they encounter, give hope that we can maintain thriving and functioning communities of living things for the next 100 years.

DEDICATION

We are profoundly in the debt to the diversity of people and ideas that have made Point Blue nimble in being able to provide answers to questions about science-based conservation issues that we couldn't, or could only begin to, pose just a few years, and certainly only a few decades, ago.

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