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(1975-2000)
Professor Emeritus of Marine Biology

Legacy

I never gave any thought as to what I wanted to do with my life. When I was a young boy, I had always just assumed I would be a biologist. I grew up in the Midwest (Illinois) and loved bird-watching, butterfly collecting, and finding minnows and other fishes. When I raised my sons, I noticed they gave a lot of thought about what careers they should work towards. I never thought about it.

Why did I turn to marine biology before having any experience in the ocean? It also came suddenly, without real thought. In high school and undergraduate college, I had a part-time job with the Department of Economic Entomology at the Illinois Natural History Survey. Among other duties, I would take sweep-net samples of insects in alfalfa fields. In order to select certain small targeted species from the buzzing cloud of hundreds of insects, I would pour the contents of the net into the cab of the survey's pickup truck, so the hundreds of insects would go to the sunlight on the inside of the windshield. This put them in two dimensions on the windshield, so I could pick them individually.Central Illinois can be very hot and humid in the summer, especially in the closed cab of a pickup truck in the direct summer sun on an alfalfa field. I was sweating profusely while I was collecting insects from the windshield, so many other insects that were still flying around landed and got caught in the sweat on my face.

I got a glimpse of marine life when I was taking a course on invertebrate zoology at the University of Illinois. A piece of reef rock with a variety of living invertebrates was on display in a laboratory session. The diverse arrays of insects in my sweep-net samples were all little 6-legged arthropods. Almost each of the animals on the reef rock were from different phyla: a brittle star, a crab, a snail, a sponge, an anemone, a polychaete worm, and others. Each of these creatures had a body plan fundamentally different from the others and the thought of how they interacted with each other was very interesting. The thought of having my face in fresh ocean water was more attractive than being in a hot pickup truck cab with insects all over your face. Furthermore, I could move in three dimensions easily in the ocean. While birdwatching, it was usually challenging to get a good look at a bird high in a tree that most often went behind the foliage when I was stuck on the ground. My interest in marine life developed in a few seconds, far from the ocean, while looking at the life on the reef rock in the class laboratory session in Illinois.

I earned my PhD in 1970 at the University of Washington in Seattle and then got a post-doc at the Smithsonian Tropical Research Institute in Panamá (1970-1975).After 5 years as a post-doc, I was ready for a tenure-track position. I loved the full-time research of a

post-doc, but I got tired of having to apply each year for a grant for financial support. I was looking for a steady income. In addition, as a coral-reef ecologist, Micronesia and the western Pacific was a Shangri-La to me. I was not disappointed on either matter. It was a good decision that shaped my life.

I was hired at the UOG Marine Lab in August of 1975. I came to UOG expecting to teach a class in marine ecology, but upon arrival a couple of weeks before classes started, I was told I must teach Biometry (statistical analysis) because the previous teacher (I think he was in agriculture) just left. I had no previous thoughts of teaching Biometry, so the first semester was the hardest work I have ever done. It was fortunate that I was not married and with a family, because I could have given them little attention. I worked full time to keep ahead of the students that first year. I wound up teaching Biometry for 26 years (1975-2000) without a break. After the first year or two, I began to enjoy the course. I had personal fun making up data for examples of tests in lectures or for examsfrom current research projects that were being done at the time by professors at the UOG Marine Lab. I always tried to make them look smart.

My turn at being Director of the UOG Marine lab was 1979-1982.I retired as Full Professor. I retired in September 1999 because it was the time that was best for my retirement finances, but I taught Biometry one last time during my first months of retirement. I stayed at the marine lab until June 2000, when I took a federal position with USGS at the University of Hawaii at Manoa (in Honolulu). The reason I stayed in Guam until June was to allow my sons to finish their school year. My older son graduated from high school and my younger son finished middle school. They had both been at St. John's since first grade.

I was asked to tell of special colleagues to be remembered. There are so many special colleagues and students, it would be impossible to tell of them all, so I will only tell of two that have recently passed away, Roy Tsuda and Lucius Eldredge.

I was originally hired as a replacement of Dr. Masashi Yamaguchi at the UOG Marine Lab. I signed my employment papers and left the Smithsonian Tropical Research Institute in Panamá where I completed a 5-year post-doc. I arrived to find the Governor of Guam at the time considered the Marine Lab was not worthwhile for the University and so he did not approve the filling of the previous UOG Marine Lab position. Roy Tsuda was the Director of the Marine lab at that time and he resourcefully found a position in the Music Department that was vacant at the time. On paper, I was employed my first year (1975-1976) by the Music Department, but of course I actually worked at the Marine Lab. This action to deal with a difficult situation calmly, logically, and intelligently was typical of Roy Tsuda during my entire 25 years at the UOG Marine Lab.

Lu Eldredge was renowned for compiling files of every publication, including technical reports, grey literature, and even newspaper and magazine articles on the marine fauna of Pacific islands, both by animal group and by island. Lu may have started a search for specific facts, but he always wanted to learn the whole story and would dig deeper when

most others would have considered they had enough. Lu was an encyclopedic source of information on the tropical Pacific. When a student or colleague asked for information on a little-known creature or location for which there seemed to be almost no information, Lu would find important information from obscure sources in his files. In my 25 years at the UOG Marine Lab, Lu was the first stop for obscure literature.

I was asked to tell of academic awards:

- Scientific Diving Lifetime Achievement Award from the American Academy of Underwater Sciences, awarded October 2015
- Science Award for 2007 from the Academy of Underwater Arts & Sciences Award for Outstanding Scientific Advancement of Knowledge presented by the U.S. Coral Reef Task Force on 7 November 2005
- Award for outstanding leadership and determination to produce the first nationwide report on the condition of U.S. coral reefs - The State of Coral Reef Ecosystems in the United States and Pacific Freely Associated States presented by the U.S. Coral Reef Task Force in October 2002
- ISRS Fellow of the International Society for Reef Studies, awarded 2016
- Honorary Life Fellow of the Pacific Science Association, award presented at IX Pacific Science Intercongress, Taipei, 16 November 1998
- First Excellence in Research Award, University of Guam
- Member of the Ancient Order of the Chamorri of the Island of Guam, presented by Governor Carl T.C. Gutierrez and Speaker Antonio R. Unpingco, 25th Guam Legislature, 24 September 1999
- Chi Omicron Gamma --- Honorary Scholastic Society of the University of Guam
- Kava Bowl with plaque "In appreciation of your services to the coral reefs and people of American Samoa since 1979" presented by the Division of Marine and Wildlife Resources, Government of American Samoa, May 2017
- Professor Emeritus, University of Guam

I was asked to tell of notable publications.

Some books were:

- Birkeland, C. (ed.) 2015. Coral Reefs in the Anthropocene. Springer, Dordrecht. 271 p.
- Birkeland, C. (ed.) 1997. Life and death of coral reefs. Chapman & Hall, New York. 536 p.
- Birkeland, C., and J.S. Lucas. 1990. *Acanthaster planci*: major management problem of coral reefs. CRC Press, Boca Raton. 257 p.

Some choices of papers that I feel (personally) are notable are:

- Birkeland, C., A. Green, A. Lawrence, G. Coward, M. Vaeoso, and D. Fenner (2021) Different resiliencies in coral communities over ecological and geological time scales in American Samoa. Marine Ecology Progress Series 673: 55-68

  This paper reports on a coral-reef transect that was surveyed eleven times between 1917 and 2019, over a period of 102 years. We found that the coral community on the reef crest was repeatedly damaged by hurricanes, crown-of-thorns outbreaks, and other damaging events, but the community always recovered rapidly. In contrast, the coral community on the adjacent bordering reef flat, although starting with the more abundant coral community, steadily deteriorated over the century. The resilience of the community on the reef crest was a result of wave action stimulating the deposition of the special limestone dolomite by algae. The dolomite is especially stable and enhances the binding of the substrata. The resilience of an entire community is a result of the effects of wave action on deposition of a chemical, dolomite.

- Birkeland, C (2017) Working with, not against, coral-reef fisheries. Coral Reefs 36: 1-11

  This paper explains how harvestinga fisheries stock when it is above the stock size at its maximum sustainable yieldis actually working favorably for the fishery because removing some stock to lower numbers of fish increases productivity by allowing more food or other resources per fish. There is negative feedback by reducing stock when at high concentrations reduces competition which increasesproductivity. However, when the stock is harvested where resources are below the level of maximum sustainable yield where there is no competition, the reproductive stock is reduced and therefore the rate of replenishment is reduced. There is positive feedback where reducing the reproductive stock reduces the reproductive output. Much of the world'sfisheries are overharvested and in decline because they are harvesting beyond the maximum sustainable yield. This was originally presented as a plenary talk at the International Coral Reef Symposium.

- Forsman, Z.H., and C. Birkeland (2009)*Porites randalli*: a new coral species (Scleractinia, Poritidae) from American Samoa. Zootaxa 2244: 51-59

  Dick Randall (a member of SEPRS) was my mentor in coral identification. I remember our first trip to American Samoa to do surveys of corals when he told me to call a certain species "*Porites* sp. 2", because he recognized immediately that it was an unnamed species. It was called "*Porites* sp. 2" for 30 years, even by others such as Australians that did research in American Samoa. I had been planning for decades to name the species after Dick, but I am not a geneticist. I partnered with Zac Forsman, a geneticist, and we described the new species *Porites randalli* which I felt was very appropriate.

- Birkeland, C (1989) The Faustian traits of the crown-of-thorns starfish. American Scientist 77: 154-163

  I find it interesting that the morphological traits that allow the crown-of-thorns to successfully increase in abundance and take over, in contrast to other coral-reef starfish species, eventually lead to its demise, also in contrast to other coral-reef starfish.

- Birkeland, C (1982) Terrestrial runoff as a cause of outbreaks of *Acanthaster planci* (Echinodermata: Asteroidea). Mar. Biol. 69:175-185

  In 1988, my mother sent me a note that a recent lengthy (24-page) article in The New Yorker magazine about the "crown-of-thorns" had a discussion of my 1982 paper that began with "Charles Birkeland appeared just in time to rescue the despairing mainstream biologists. A biologist at the University of Guam…"

- Birkeland, C., F.-S. Chia, and R.R. Strathmann (1971) Development, substratum selection, delay of metamorphosis and growth in the seastar, *Mediasteraequalis* Stimpson. Biol. Bull. 141: 99-108

  We discovered that larvae of the seastar *Mediasteraequalis,*which were lecithotrophic (grew on yolk, had no mouth or digestive system to feed) and normally metamorphosed to seastars in less than one month, could live for 14 months and still successfully metamorphose if given the appropriate substratum to stimulate settlement and metamorphosis.

1979 --- Dick Randall, his wife Belay, and our UOG ML marine tech boatman Frankie Cushing (second from right). We were pleasantly going through protocol to ask permission to do surveys on American Samoan reefs.

1996 --- The first six presidents of the International Coral Reef Society (at the time International Society for Reef Studies). I was the third president.

1997 --- A jam session of the Pago Bay Reefers