50 years of recorded SCUBA observations link authors to their marine "home"

"About 20 years ago someone asked me, 'Who funds this database?' I looked at them rather blankly and said, 'We do!'"

DONNA GIBBS, TAXONOMIST WITH PACIFIC MARINE LIFE SURVEYS, INC.

AUTHORS

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What's happening?

For 50 years, diver and marine naturalist Andy Lamb has been meticulously recording and quantifying everything he sees underwater. For 25 of those years, Donna and Charlie Gibbs have been augmenting the list with observations made on their own dives. To preserve this invaluable history of marine life, Donna, a taxonomist, painstakingly entered 1,600 of Andy's hand written records (Figure 1) into a digital database, while Charlie, a software engineer, developed systems to manage and easily extract data based on specific searches. The result of this "labour of love" is a searchable database of species-specific observations from over 4,920 dives at 1,200 locations in B.C., Alaska, Washington, Oregon, and California. The effort that has gone into developing and maintaining this store of knowledge epitomizes the strength of the connection between these divers and their marine home.

For many years some folks "in-the-know" have been aware of this effort, called Pacific Marine Life Surveys Inc. (PMLS), although it has not been widely recognized, nor publicly accessible. Donna receives and answers requests for data regularly.

Dive # 715
Date : July 31, 1986
Weather : Sunny, hot, calm
Buddy : John Rawle
Place : Eagle Point, San Juan Island
Depth : 0-114 ft ; 40ft vis
Purpose : Collecting
P.

Time : 1:10 - 2:11 pm
Tide ↗ High

Specimens observed :

Nereocystis, woody stemkelps, short branching reds, coralline (kinds sorted) flat codium, ulva

Tetilla orb (few)
Phakellia sp. (few)
Suberites montingiger
Isodictya quatsinoensis (some)
Oplitospongia pennata (some)
Metridium senile (large white abund)
*Cribrinopsis fernaldi (abund)
Stemphia dideman (1)
Tealia crassicornis (many)(various colours)
Epiactis prolifera (many, red on woody stem kelps)
Epizoanthus scotinus (some)
Balanophyllia elegans (many)
Clavularia sp. (some, shallow)
Allopora petrographa (some)
Abietinaria greeni (much)
Garveia annulata (much)
Hydractinia milleri (some)
Tubularia crocea (much)
Corynorpha palma (few)
Aequorea aequorea (abund)
Cyanea capillata (few)
Phidiidium sp. (abund)
Pleurobrachia bachei (many)
Serpula vermicularis (many)
Spirorbis sp. (many)
Dodecaceria fewkesi (some)
Telephus crispatus (some)
Pista elongata
Membranipora membranacea (much)
Crisia sp. (much)
Bugula californica (much)
Schizoporella biconnis (much)

Dendrobeania lichenoides (much)
Phidolopora pacifica (1)
Diaperoecia californica (abund)
Heteropora pacifica (much)
Borentsia / Camponularia (much)
Cryptochiton stelleri (many)
Tonicella lineata (many)
T. insignis (few)
Mopalia sp. (some)
Acmaea mitra (v. abund)
Haliotus kamschatkana (1)
Serlessia dira (some)
Trichotropsis conicelleta (many)
Fusitriton oregonsis (many)
Ceratostoma foliatum (some)
Calliostoma ligatum (abund)
C. annulatum (some)
Ocenebra lurida (many)
Amphissia columbiana (abund)
Petaloconchus compactus (some)
Sabellaria cementarium (few)
Diopatra ornata (1)
Chlamys sp. with Mytilus/Mytilla (abund)
Hinnites giganteus (few)
Mytilimeria nuttalli (few)
Entodesmus saxicola (few)
Diriona albolineata (some)
Hermissenda crassicornis (some)
Coryphella trilineata (many)
Dendronotus dalli (few)
D. diversicolor (some)
Adalaria sp. (some)

*Rossia pacifica (1)
*Podocerus cristatus (1)(red)
*Lebbeus grandimanus (1)
Heptacarpus kincaidi (many)
Pandalus danae (many)
Scyra acutifrons (some)
Phyllolithodes papillosus (1)
Discorpagurus schmitti (1)
Pagurus beringanus (many)
*Elassochirus gilli (1, large)
Cirolana harfungi (2 on blade)
Balanus nubilus (some)
B. glandula (some)
Dermasterias imbricata (large)
Orthasterias koehleri (few)
Leptasterias hexactis (many) (various colours)
Pycnopodia helianthoides (few)
Solaster dawsoni (1)
S. stimpsoni (few)
Cucumaria miniata (many)
C. targus (v. abund)
Eupentacta quinquesemita (some)
Psolus chitonoides (many)
Strongylocentrotus franciscanus (2)
S. purpuratus (1)
Corella willoceriana (few)
Styela gibbsii (some)
Boltenia villosa (some)
Cnemidocarpa finmarkiensis (few)
Chelyosoma productum (some)
Metandrocarpa taylori (abund)
Pyuroclavella stanleyi (many)
(over)

Notes : dove from Charlies shamrock
nice dive much time shallow, some deep, cruised with black rockfish
found 2 sinkers, 1 buzz bomb, 1 silda

* specimens collected

Figure 1. Hand-written dive log from 1986.

Why is it important?

This database contains information on over 1,200 species – fishes, invertebrates, plants including algae – observed over the past 50 years. These observations have proven useful in many applications to date. For example, in 1998 when Parks Canada requested data to support establishment of a National Marine Conservation Area in the Southern Gulf Islands, the database provided information on 593 species from 325 dives. When sea star wasting syndrome was first recognized in 2013, the PMLS database revealed a history of the vanishing species, including where they had been observed and their abundance. Changes since then have been analyzed as well. More recently, Fisheries and Oceans Canada (DFO) has requested data for locations of interest for an evaluation of nearshore EBSAs (Ecologically and Biologically Significant Areas). The database provided lists of species with relative abundance.

In 2011, the database was used as a source of information to investigate documented climate regime shifts. Authors looked for changes in species biodiversity in the zone observed by SCUBA divers across time periods delineated by regime shifts.[1] Results are inconclusive as statistical tests were not supported, but the data appear to show that a regime shift in 2000 led to reduced biodiversity – likely only for the more rare species.

In 2015, the software was used in the Sitka Field Data Report for a Marine Biodiversity Project.[2] The Sitka Foundation provided the funds for the Vancouver Aquarium to learn how to teach field identification skills to interested divers. We trained professional divers along with sport divers to hone their identification skills and analyzed the results. This project recognises the importance of morphological taxonomy (identifying species by their outward appearance, form, and structural features) as a skill. Fewer professionals specialize in morphological taxonomy, instead focusing on more "cutting edge" skills that take advantage of new technology. Without efforts like the PMLS, the ability to visually identify marine life could be a lost skill in the next generation of marine scientists.

Left to right, Andy Lamb, Donna Gibbs, and Charlie Gibbs. (Photos courtesy of Donna Gibbs)

Is there a particular importance or connection to First Nations?

For over two years the database has been used to report on the settlement of species on the HMCS Annapolis, a decommissioned naval ship sunk in 2015 to become reef habitat in Howe Sound. The Squamish Nation approved the project and tracks the information on species observed there as the diversity increases.

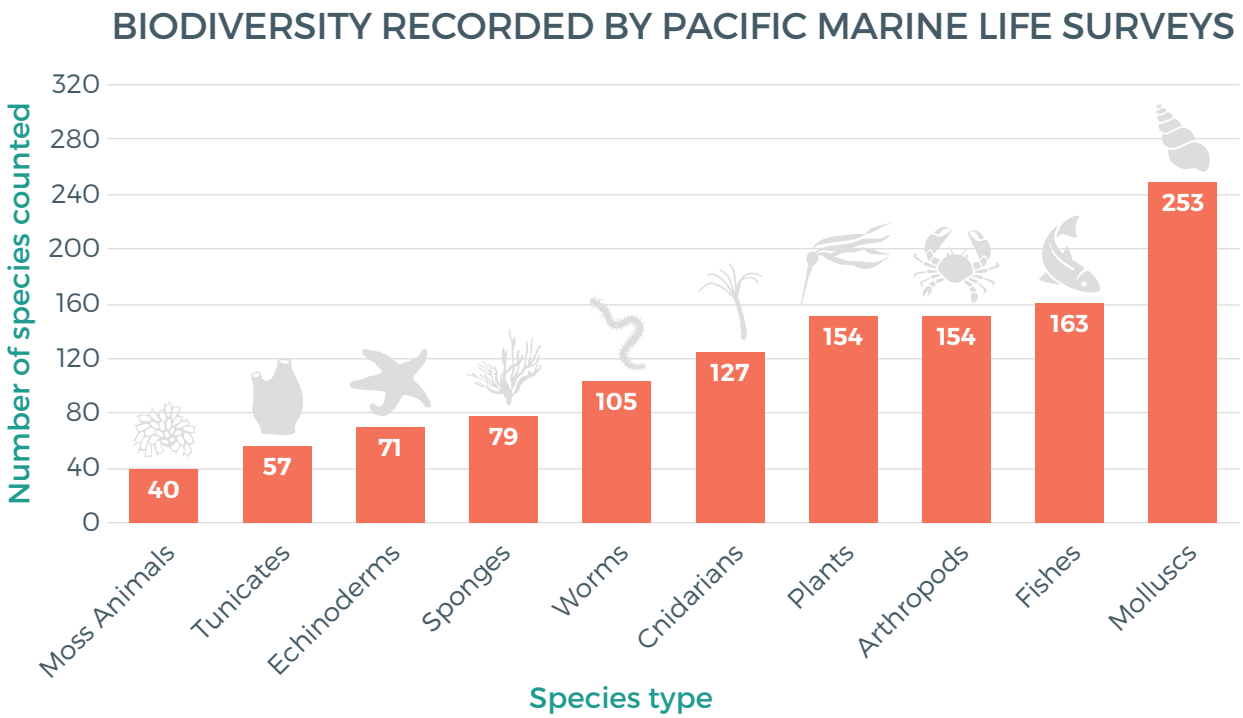


Figure 2. Number of species observed in each of ten taxonomic phyla.

Photo: Jenn Burt

What is the current status?

In 2017, a handful of divers contributed data regularly to the database. A certain level of experience is required to properly identify the range of species observed in coastal B.C., and Donna takes care to ensure each diver has that experience and can identify species accurately. Members of the Howe Sound Research and Conservation dive team at the Vancouver Aquarium are regular contributors.

The database now documents over 1,200 species in ten phyla that have been recorded (Figure 2). The spatial extent of records includes the entire length of the coast of B.C., into Alaska to the north, and as far as California to the south (Figure 3).

Species observations recorded in the PMLS database are better suited for some studies than for others for

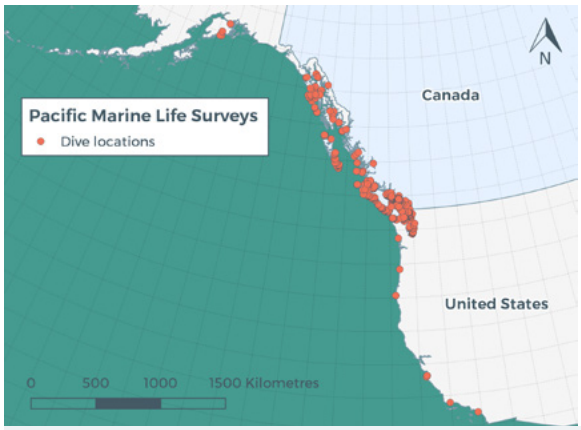


Figure 3. PMLS dive locations.

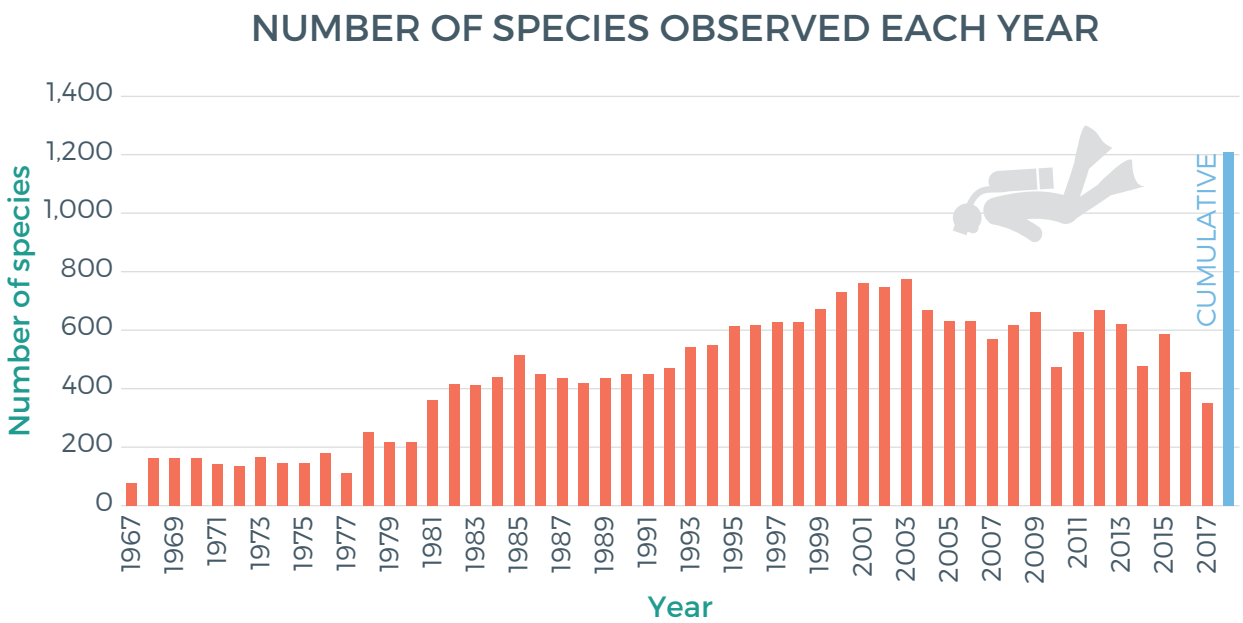


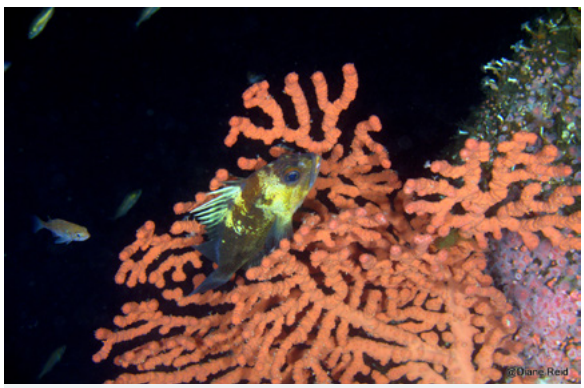
Figure 4. The number of species observed each year varies with the number of dives recorded and with the accumulated experience of the divers. The more experience, the more species identified and recorded. Also, fewer plants were identified in the 1960s and 1970s.

several reasons. The collection is a set of species observations by location with some accompanying habitat descriptions. Species absence from a site at any time cannot be inferred, and abundance estimates are relative. The effort expended to gather observations is not standardized. Each unit of effort is a dive and all dives are not equal due to individual differences in diver skills, including observation and taxonomic identification. Further, the distribution of dives in space and time is not consistent or standardized. The taxonomic expertise of divers increases with experience, such that the number of species identified per year increased for many years, peaking in 2003, and shows variability since then (Figure 4). For a record of biodiversity, the length of the time series and the geographic extents are rare and valuable. According to the PMLS database, biodiversity (within diving depths) among regions of the B.C. coast does differ.[3] The database is well suited to support site-specific explorations, biodiversity comparison among regions, and comparison across time periods.

What is being done?

Development of the database and interface software is ongoing, to make it more flexible and easy to use. Charlie adds new features as required to satisfy new reporting requests, or to make it easy to export results in formats required by other organizations (e.g., iNaturalist). Data collection is continuing, enabling discovery of new trends or changes in species communities that may be linked to environmental changes. Records from the past 50 years can be used to pinpoint areas to be revisited to answer specific research questions.

The structure and function of the database were used as a model for work that started in the Arctic in 2014. Species observations from Arctic research expeditions (an Ocean Wise initiative run by the Vancouver Aquarium Marine Science Centre) are being collected and recorded in a similar database.



Juvenile rockfish with coral. (Photo: Diane Reid)

What can you do?

Individual and Organization Actions:

- Report unusual SCUBA observations along with location data and photos to Donna.Gibbs@ocean.org. Credible observations will be added to the database.
- Study the taxonomy of biodiversity in nearshore marine habitats.

Government Actions and Policy:

- Support citizen science programs that encourage and facilitate learning about the marine environment.
- Encourage university students to study taxonomy.

Footnotes

[1] Marliave, J.B., Gibbs, C.J., Gibbs, D.M., Lamb, A.O. and S.J.F. Young. 2011. Biodiversity Stability of Shallow Marine Benthos in Strait of Georgia, British Columbia, Canada Through Climate Regimes, Overfishing and Ocean Acidification. In: Grillo, O. (Ed.) Biodiversity Loss in a Changing Planet, InTech. DOI: 10.5772/24606. Available from: https://www.intechopen.com/books/biodiversity-loss-in-a-changing-planet/biodiversity-stability-of-shallow-marine-benthos-in-strait-of-georgia-british-columbia-canada-throug Accessed July 6, 2017.

[2] The Marine Biodiversity Project. Accessed February 13, 2018. http://www.vanaqua.org/marine-biodiversity/.

[3] Marliave et al. 2011

Donna diving on the HMCS Annapolis in Howe Sound. (Photo: Diane Reid)