# 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.

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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.

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Tenis crassicomis (many) (various calours) Acqueen meitra (vaband) Elassochirus gulli, (1) Jarge Epiachis prolitere (many) (various calours) Acqueen meitra (vaband) Elassochirus gulli, (1) Jarge Epiachis prolitere (many), red on wrody stem kolp)  Epizoanthus scotinus (same) Haliotus kamerchatkana (1) Balanus mubilus (same)  Epizoanthus sectionus (same) Haliotus kamerchatkana (1) Balanus mubilus (same)  Sericasia dira (same) Balanus mubilus (same)  Clayalaria sy. (same shallow) Trichatropsis cancellota (many) Permasterias imbricata (la Allopara petrograpta (same) Tristatopsis cancellota (many) Dermasterias imbricata (la Allopara petrograpta (same) Fusitatoria orangaissi (many) Orbasterias kochleri (tau)  Abietharia greeni (much) Centotoria feliata (same) Leptasterias besahilis (many)  Garvien annulatum (much) Centotoria feliata (same) Leptasterias besahilis (many)  Garvien crocea (much) Centotoria lurida (many) Salaster dausani (1)  Ceryparepha palma (tew) Amphissia columbiana (sama) Salaster dausani (tau)  Ceryparepha palma (tew) Amphissia columbiana (sama) Suspendia helianthuides (1)  Ceryparepha palma (tew) Salaster dausani (tau)  Ceryparepha palma (tew) Amphissia columbiana (sama) Suspendia helianthuides (1)  Ceryparepha palma (tew) Salaster dausani (tau)  Salaster dausani (tau)  Salaster dausani (tau)  Salasteria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Ceryphalia palma (tau)  Diopatra capillatus (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)  Diopatra (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)	Metridium senile ( large white a	bund) lonicella linesta (many) Phyllolithodes payillosus (1)
Tenis crassicomis (many) (various calours) Acqueen meitra (vaband) Elassochirus gulli, (1) Jarge Epiachis prolitere (many) (various calours) Acqueen meitra (vaband) Elassochirus gulli, (1) Jarge Epiachis prolitere (many), red on wrody stem kolp)  Epizoanthus scotinus (same) Haliotus kamerchatkana (1) Balanus mubilus (same)  Epizoanthus sectionus (same) Haliotus kamerchatkana (1) Balanus mubilus (same)  Sericasia dira (same) Balanus mubilus (same)  Clayalaria sy. (same shallow) Trichatropsis cancellota (many) Permasterias imbricata (la Allopara petrograpta (same) Tristatopsis cancellota (many) Dermasterias imbricata (la Allopara petrograpta (same) Fusitatoria orangaissi (many) Orbasterias kochleri (tau)  Abietharia greeni (much) Centotoria feliata (same) Leptasterias besahilis (many)  Garvien annulatum (much) Centotoria feliata (same) Leptasterias besahilis (many)  Garvien crocea (much) Centotoria lurida (many) Salaster dausani (1)  Ceryparepha palma (tew) Amphissia columbiana (sama) Salaster dausani (tau)  Ceryparepha palma (tew) Amphissia columbiana (sama) Suspendia helianthuides (1)  Ceryparepha palma (tew) Salaster dausani (tau)  Ceryparepha palma (tew) Amphissia columbiana (sama) Suspendia helianthuides (1)  Ceryparepha palma (tew) Salaster dausani (tau)  Salaster dausani (tau)  Salaster dausani (tau)  Salasteria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Diopatra crantarriani (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Centotoria palma (tau)  Diopatra crantarriani (tau)  Ceryphalia palma (tau)  Diopatra capillatus (tau)  Centotoria palma (tau)  Permasteria palma (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)  Diopatra (tau)  Ceryphalia palma (tau)  Ceryphalia palma (tau)		1. Insignis (tow) Discorpagurus schmitti (1)
Testis prolifera (many) (various caleurs) Atomaea mintra (vabend) Elassochirus gulli (1 large Epischis prolifera (many) red on weedy shan kelp)  Episconthus sections (many)  Balanephyllis elegans (many)  Allebara petrograpta (some)  Allebara petrograpta (some)  Allebara petrograpta (some)  Fishitoro oreanasis (many)  Carsostama telistam (some)  Leptaskrias beaathis (many)  Abretharia greeni (much)  Carsostama telistam (some)  Leptaskrias beaathis (many)  Garvien annulatum (much)  Callostoma ligatum (aband) (various colours)  Hydrochina milleri (some)  Cancebra lurida (many)  Selaster daussoni (1)  Ceryparpha palma (tew)  Anghissia colombiana (aband)  Selaster daussoni (1)  Ceryparpha palma (tew)  Anghissia colombiana (aband)  Selaster daussoni (1)  Ceryparpha palma (tew)  Sabebaria cancentarium (some)  Cyanea capillatus (few)  Sabebaria cancentarium (few)  Chamya sp. (aband)  Pleurobrechia bachei (many)  Selaster (many)  Selaster daussoni (some)  Pleurobrechia bachei (many)  Hinniks gigan taus (two Strongylocentrola franciscamus  Sepala rermicularis (many)  Dedececeria fawkii (some)  Pirana albolineata (some)  Selaster (some)  Pirana albolineata (some)  Pirana albolineata (many)  Bagula californica (much)  Ceryphella trilinata (many)  Cerisia sp (much)  Bagula californica (much)  Ceryphella trilinata (many)  Cerisia sp (much)  Bagula californica (much)  Corolina shilosi (some)  Pirana albolineata (some)  Piranoclavella stanleyi (some)  Rendonnotus delli (tew)  Corolla villoceriana (some)  Piranoclavella stanleyi (mony)  Notes: deue from Charlies shomrock  nice dire much time shollow , some deep , craised with black rockfish	Stomphia didemon (1)	Mopalia sp. (some) Pagurus beringanus (mang)
Epischis prolifera (many, red on wrody stem kelps)  Episcoanthus scotinus (soma)  Balanophyllia elegans (many)  Seriessia dira (soma)  Balanophyllia elegans (many)  Seriessia dira (soma)  B. glandula (soma)  B. glandula (soma)  B. glandula (soma)  Clayularia sp. (soma shallow)  Fuithfrian oregosus (many)  Orbisherias kochler (har)  Abietharia greeni (much)  Gratostoma feliatu (soma)  Leptasterias becarlis (many)  Garvien annulatum (much)  Gratostoma feliatu (soma)  Leptasterias becarlis (many)  Garvien annulatum (much)  Gollistoma ligatum (abund)  Leptasterias becarlis (many)  Hydractinin milleri  Genetra lurida (many)  Selaster dausoni (tau)  Anghissin columbiana (abund)  Selaster dausoni (tau)  Anghissin columbiana (abund)  Selaster dausoni (tau)  Pulidium sp. (abund)  Peterobrachia bachei (many)  Sabelbaria camentarium (faw)  Cucumbria minista (soma)  Plearobrachia bachei (many)  Selaster (many)  Selaster dausonita (soma)  Plearobrachia bachei (many)  Selaster (many)  Hinniles gigantous (tuw)  Strongylocentrotus fromissamul  Spirorbis sp. (many)  Dedececeria tawkii (soma)  Hinniles gigantous (tww)  Strongylocentrotus fromissamul  Spirorbis sp. (many)  Dedececeria tawkii (soma)  Pirana albelineata (soma)  Stycla jibbili (soma)  Pirana albelineata (soma)  Membranipora membranacea (much)  Crisia sp. (much)  Bagulla calitarinea (much)  Pendronotus delli (tew)  Crisia sp. (much)  Bagulla calitarinea (much)  Pendronotus delli (tew)  Chelysonia productum (soma)  Bagulla calitarinea (much)  Schizoporella biconia (much)  Adalarin sp. (soma)  Rene dere much biack rockish  rice dire much time shollow, some deep, cruised with black rockfish	Tealiz crassicornis (many) (various	colours) Acrosea mistra (v. aband) Elassochirus gilli (1 large)
Epizoanthus scotinus (some) Hollotus komschatkana (1) Balanus nubilus (some) Balanophyllia elegans (many) Scricosia dira (soma) B. glandula (some) Clevularia sp. (some, shallow) Trichotropsis cancellota (many) Bermasterias imbricata (la Allopora petrograpta (some) Fusitriton oregonis (many) Orbisterias kochlor (fam) Abietinaria greeni (much) Ceratostoma teliatua (some) Leptasterias beautilis (many) Garvien annulatur (much) Callostoma ligatua (abund) (varieu) colours) Hydractina milleri (some) C. Samela (many) Selaster dauseni (1) Cerypaorpha palma (few) Amphissia columbiana (abund) S. stimpani (faw) Acquerea acquerea (abund) Peteleconchus compactus (some) Cucumbria minista (namy) Cyanea cepillatus (few) Sabeloria cancentarium (faw) C. tarqua (v. abund) Plalidium sp. (abund) Diopatra ornat (1) Eugentacta quiaquesteriata (som Plearobrechia bachei (many) Hinni les sigantaus (few) Strongylocentrotus franciscanus Serpula vermicularis (many) Hinni les sigantaus (few) Strongylocentrotus franciscanus Spirorbis (many) Hinni les segantaus (some) Syela gibbii (some) Plearopracia fewksi (some) Entodesmus saxicola (few) Corella willocrina (few) Prona albolinata (some) Shyela gibbii (some) Prona albolinata (some) Shyela gibbii (some) Pendonorus dalli (few) Chelyosom productum (some) Pendonorus dalli few)		
Belanophyllia elegans (many)  Clevularia sy. (some shallow)  Trich tropsis cancellata (many)  Allopara petrograpta (some)  Allopara petrograpta (some)  Abietinaria green; (much)  Geratostoma teleata (some)  Aprina annulatum (much)  Geratostoma teleata (some)  Leptasterias besahlis (many)  Garvien annulatum (much)  Gelliostoma ligatum (abund)  Leptasterias besahlis (many)  Hydractima milleri (some)  Comebra lurida (many)  Solaster dawsoni (1)  Coryparpha palma (tow)  Amphissia columbiana (abund)  Solaster dawsoni (1)  Coryparpha palma (tow)  Angueret acquorea (abund)  Petelocenchus compactus (some)  Cyanea capillatus (tow)  Sabellaria conentración (tow)  Cyanea capillatus (tow)  Diopatra ornate (1)  Euseatacta guiaquesenta (some)  Pleurobrachia bachti (many)  Chlomys 19. with Mysale Mysilla (sound) Psolus chitamides (many)  Serpula vernicularis (many)  Chlomys 19. with Mysale Mysilla (sound) Psolus chitamides (many)  Serpula vernicularis (many)  Mytilmeria metholi (tow)  Dodececeria fewkis (some)  Prona albolineata (sone)  Pista elagata  Membranipora membranacea (much)  Piròna albolineata (sone)  Sendo Crestia fewkis (some)  Pirona albolineata (sone)  Pinderatio por Metandrocarpa tanglori (abund)  Bagula colifornica (much)  Dodececeria fewkis (some)  Pirona albolineata (sone)  Pista elagata  Membranipora membranacea (much)  Pendronotus delli (tow)  Supurclavella stanleyi (abund)  Schizaporella biconis (much)  Adalaria sp. (sone)  Rendronotus delli (tow)  Rendronotus delli (tow)  Rendronotus stanleyi (many)  Notes deve much time shallow, some deep, cruised with black rockfish		
Clegalaria sy. (some, shellow) Trichutropsis concelleta (many) Bermasterias imbricata (la Allopara petrograpta (some) Fusitivitan oregonsis (many) Orbinsterias kochleri (few) Abbietinaria greeni (much) Ceratostoma felicitae (some) Leptasterios besahilis (many) Garvigen annulatum (much) Colliostoma ligatum (abund) (variou) colours) Hydroctina milleri (some) C. Rycnopodia helientheides (tabelaria crocea (much) Ocenebra luvida (many) Solaster dawsoni (1) Cerypaorpha palma (few) Amphissia columbiana (abund) S. stimpsoni (few) Acquarea acquarea (abund) Petalecenchius compactus (some) Cucumaria miniata (nony) Cyanea capillatus (few) Sabelaria camentarium (few) C. tarqua (v. abund) Pulidium sp. (abund) Diopatra arnota (1) Eugentecta quiaquesemita (son Plearobrachia bachei (many) Chlamys sp. with Mysale (Mysilla (abund) Balus chitomoides (many) Serpula varnicularis (many) Hinnists gigantous (few) Strongylocentratus franciscamus (Spirorbis sp. (many) Mytilmeria muttalli (few) S. parparrtus (Sone) Podececeria fewkii (some) Pirona albolineata (sone) Styela gibbiii (sone) Pista elaagota (sone) Pirona albolineata (sone) Styela gibbiii (sone) Pista chagota (much) Ceryphella trilineata (many) Cremidocarpa trinnarkiensis (Crisia sp. (much) Pendronotus delli (few) Chelyosoma productum (sone) Schizoparella biconnis (much) Adalaria sp. (sone) Bynoclavella stanleyi (many) Noles: doue from Charlies shamock nice dire much time shollow, some deep, cruised with black rockfish	Rahmal III: eleans (man)	Section dia (see) B ab the Garage
Abbetinaria greeni (much) Ceratasterna tolicitan (sence) Leptasterias kochleri (tear) Abbetinaria greeni (much) Ceratasterna tolicitan (sence) Leptasterias bezarlis (many) Garvien annulatum (much) Collicatorna ligatum (abund) (varieu) (alours) Hydractina milleri (sonce) C. annulatum (sonce) Rycopodia helicattroides (tolicatoria crocea (much) Ceenebra liurida (many) Solaster daursoni (1) Cerymorpha palma (teu) Amphissia colembiana (abund) S. atimpani (tau) Aequorea aequorea (abund) Petaloconchius compactus (sonce) Cucumaria miniata (ranny) Cyanea capillatus (teu) Sabebaria camentarium (tou) C. tarqua (v. abund) Philiduim sp. (abund) Diopatra ornata (1) Eugentacta quiqquesemita (sonce Pleurobrachia bachei (many) Chlomyc sp. with Mycale (Mysilla abund) Psalus chitanides (many) Serpula vernicularis (many) Hinnides gigantaus (tou) Strongylocentratus franciscanus (Spirorbis sp. (many) Mytilmeria nuttolli (tou) S. parpuratus (tou) Dedececeria fewkii (sonce) Entodesmus saxicolai (teu) Corella villocatora (tou) Pista elangota (sonce) Dirona albolineata (sonu) Stycla gibbiii (sonu) Pista elangota (much) Ceryphella trilineata (many) Genidocarpa finnarkiensis (Crisia sp. (much) Pendronotus delli (teu) Chelyosoma productum (sonu) Schizaporella bicoonis (much) Adalaria sp. (sonu) Byunoclavella stanleyi (many) Noles: dove from Charlies shamock nice dire much time shallow, sonue deep, cruised with black rockfish	Ch. L. C.	Till I III
Abietinaria greeni (much) (erstostoma tolista (some) Leptostorios beachlis (mony) Gervien annulatum (much) Celliostoma ligatum (abund) (various colours) Hydroctina milleri (some) C. annulatum (some) Pycnopodia helientheides (tolistoria crocea (much) Ocenebra luvida (mony) Soloster dausoni (1) Coryporpha polma (tow) Amphissia columbiana (abund) S. stimpsoni (tow) Acquorea acquorea (abund) Petoloconchus compactus (some) Cucumaria miniata (nony) (yanea capillatus (tow) Sabellaria camentarium (tow) C. tarqua (v. abund) Pleurobrechia beahei (many) Diopatra annuta (mony) Eupentacta quiquesenista (some) Pleurobrechia beahei (many) Chlomys sp. with Mycale/Mysilla (abund) Psolus chitamoides (mony) Serpula varmicularis (mony) Hinnists gigantaus (tow) Strongylocentratus franciscanus (Spirorbis sp. (many) Dodecceeria fembrii (some) Entodesmus saxicola (tow) Sorella villaeriana (fom) Pista elangota Membranipora membranacea (much) Ceryphella trilineata (mony) Gemidocarpa tinnarkiensis (Crisia sp. (much) Pista colifornica (much) Pendronobus obelli (tow) Chelyosoma productum (some) Pendronobus obelli (tow) Chelyosoma productum (some) Pendronobus obelli (tow) Chelyosoma productum (some) Pendronobus obelli (tow) Chelyosoma taylari (abund) Schizoporella biconiis (much) Adalaria sp. (some) Pycnoclavella stanleyi (mony) Noles: dove from Charlies shamock nice dire much time shallow, some deep, cruised with bleck rockfish	All Isome , Shallow /	(richetropsis concelleta many) Vermasterias impricata lang
Service simulatum (much) Collostome ligatum (abund) (various colours) Hydractina milleri (some) C. anglatatum (some) Pycnopodia helienthoides (toularia milleri (some) Ocenebra liurida (many) Solaster dausoni (1)  Ceryprorpha palma (tew) Amphissia rolumbiana (abund) S. stimpsoni (taw) Acquorea acquorea (abund) Petoloconchus compactus (somu) Cucumoria miniota (namy)  Cyanea cepilletus (tew) Sabellaria camentarium (taw) C. tarqua (v. abund)  Philidium sp. (abund) Diopatra ornata (1) Eupentacta quiquesenita (son  Pleurobrachia bachei (many) Chlomys sp. with Mysale Mysalla (abund) Psolus chitomoides (many)  Serpula rermicularis (many) Hinni les quantosis (tew) Strongylocentratus transcisanus  Spirorbis sp. (many) Mytilmeria mutbolli (tow) S.  Dodececeria fewksii (some) Entodosmus saxicola (tew) Corella villaeviana (tew)  Pista elongota (some) Pirona albolineta (sonu) Styelo quibbis (sonu)  Pista elongota (some) Hermissenda crassicornis (sonu) Bollenia villosa (sonu)  Membranipora membranacea (much) Caryphella teilineta (many) Chemidocarpa finnarkiensis (Crisia sp (much)  Deadronotus dalli (tew) Chalyosoma productum (sonu)  Schizoporella bicomis (much) Adalaria sp. (soma) Pycnoclavella stanleyi (many)  Noles: dove from Charlies shamock  nice dire much time shollow, some deep, cruised with black rockfish	Hilopora petrograpta (some)	rusitriton oregonisis (many) Orthosterion koehleri (tea)
Springer simulation (much) (collistione lighter (some) (various colours)  Hydroction miller; (some) (come) (some) (some) (some)  Tubularia crocea (much) (some) (some) (some) (some)  Auguarea acquarea (abund) (some) (some) (some) (some)  Acquarea acquarea (abund) (some) (some) (some) (some)  Acquarea acquarea (abund) (some) (some) (some) (some) (some)  Cyanea capillatus (tem) (some) (some) (some) (some) (some) (some)  Cyanea capillatus (tem) (some) (some	Abietinaria greeni (much)	(eratostoma tolisten (some) Leptaskrius hexatilis (many)
Tubularia crocea (much)  Cerepara lurida (many)  Salaster dausani (1)  Ceryparapha palma (few)  Amphissia columbiana (abund)  Salaster dausani (few)  Amphissia columbiana (abund)  Salaster dausani (few)  Auguerea acquerea (abund)  Petaloconchus compactus (some)  Cucumaria minista (many)  Upanea cepillatus (few)  Sababaria camentariain (few)  C. tarqua (v. abum)  Plulidium sp. (abund)  Diopatra ornata (1)  Eupentacta quiquesenista (some)  Pleurobrechia bachei (many)  Chlomys sp. with Mysale/Mysilla (abund) Psolus chitamoides (mony)  Serpula vernicularis (many)  Hinnites gigantaus (few)  Strongylocentrotus transisionus  Spirorbis sp. (many)  Mytilmeria muttalli (fow)  S. parpuratus(  Dodececeria fewkii (some)  Pirona albalineata (some)  Ocella villaeriana (few)  Pista elagata  Hermissenda crassicornis (some)  Bollenia villosa (some)  Membranipora membranacea (much)  Ceryphella trilineata (many)  Cenidocarpa tinnarkiensisi (crisia sp. (much)  Diopatra oliveriscolor (sone) Metandrocarpa taylori (abun)  Schizaporella biconnis (much)  Adalaria sp. (some)  Recoclavella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shallow, some deep, cruised with black rockfish  nice dire much time shallow, some deep, cruised with black rockfish	Garview singlatum (much)	Calliostoma ligatum (abund) (various colours)
Tubularia crocea (much)  Cereptora lurida (many)  Salaster dausani (1)  Coryptorpha palma (few)  Amphissia columbiana (abund)  Salaster dausani (few)  Amphissia columbiana (abund)  Salaster dausani (few)  Auguorea acquorea (abund)  Petaloconchus compactus (some)  Cucumaria miniota (nony)  Upanea capillatus (few)  Sababaria camentarian (few)  C. tarqua (v. abund)  Plulidium sp. (abund)  Diopatra ornata (1)  Eupentacta quiquesenista (some)  Pleurobrechia bachei (many)  Chlomys sp. with Mysale/Mysilla (abund) Psolus chitamoides (mony)  Serpula vermicularis (many)  Hinniles gigantaus (few)  Strongylocentrotus transisionus  Spirorbis sp. (many)  Mytilmeria muttalli (fow)  S. parpuratus(  Dodececeria fewkii (some)  Entodesmus saxicola (few)  Ocella villoeriana (few)  Telephus crispatus (some)  Pirona albalineata (some)  Styelo gibbisi (some)  Pista elagata  Hermissenda crassicornis (some)  Bollenia villosa (some)  Membranipora membranacea (much) Caryphella trilineata (mony) Gremidocarpa tinnarkiensisi (crisia sp. (much)  Rembranipora membranacea (much)  Pendronotus dalli (few)  Schizaporella biconnis (much)  Adalaria sp. (some)  Rycnoclavella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shallow, some deep, cruised with black rockfish  nice dire much time shallow, some deep, cruised with black rockfish	Hydroctina milleri (some)	C. Some Pycnopodia helienthoides (for
Coryporpha palma (few) Amphissia columbiana (abund) S. Stimpsoni (few)  Acquerea acquerea (abund) Petaloconchus compactus (sonu) Cucumaria minista (nonny  (yanea capillatus (few) Sababaria camentariina (few) C. tarqua (v. abum  Philidiaina sp. (abund) Diopatra ornata (1) Eupentacta quiaquesemista (son  Pleurobrechia bachei (many) Chlomys sp. with Mysale/Mysilla (abund) Psolus chitamoides (mony  Serpula vernicularis (mony) Hinnites giganteus (few) Strongylocentratus franciscanus  Spirorbis sp. (many) Mytilimeria mutbolli (few) S. parparatus(  Dodececeria fewkii (sone) Entodesmus saxicola (few) (orella villocriona (few)  Telephus crispatus (sone) Pirôna albolineata (sone) Styelo gibbiii (sone)  Pista elagota Hermissenda crassicornis (sone) Bollenia villosa (sone)  Membranipora membranacea (much) Caryphella trilineata (mony) Gremidocarpa tinnarkiensisi (  Crisia sp. (much) Pendronotus dalli (few) Chelyosoma productum (sone)  Bugula colifornica (much) D. dalaria sp. (sone) Metandrocarpa taylori (abun  Schizaporella biconnis (much) Adalaria sp. (sone) Pycnoclavella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shallow, sone deep, cruised with black rockfish	Tubularia crocea (much)	
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Upanen cepillatus (tew)  Sabellaria camentarium (tew)  C. targua (v. abum  Philidium sp. (abund)  Diopatra ornata (1)  Eupentacta quiquesemita (son  Pleurobrechia bachei (many)  Chlomys sp. with Mysale/Mysilla abund Psolus chitamoides (many)  Serpula vernicularis (many)  Hinniles gigantous (tew)  Strongylocentratus tranciscionus  Spirorbis sp. (many)  Mytilmeria muttolli (tow)  S. parpuratus(  Dodececeria tewkii (some)  Entodesmus saxicola (tew) (orella villoceniana (tow)  Telephus crispatus (some)  Pista elongota  Hermissenda crossicornis (some)  Bista elongota  Hermissenda crossicornis (some)  Bollenia villosa (some)  Membranipora membranacea (much) Cryphella teilineata (many) Gremidocarpa finnarkiensis (  Crisia sp (much)  Dendronotus delli (tew)  Chelyosoma productum (some)  Bugula colitornica (much)  Crisia sp (much)  Dendronotus delli (tew)  Schizoporella biconiis (much)  Adalaria sp. (some)  Rycnoclavella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shallow, some deep, cruised with black rockfish		Petaloconchus compactus (som) Cucumaria ministra (num)
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Spirorbis sp. (many)  Dodececeria fewkii (sume)  Entodesmus saxicola (tew)  Telephus crispatus (some)  Pirôna albolineata (some)  Styleo gibbii (some)  Pista elagata  Hermissenda crassicornis (some)  Bollenia villosa (some)  Membranipora membranacea (much) Caryphella trilineata (mony) Gnemidocarpa tinmarkiensis (Crisia sp. (much)  Bugula californica (much)  Doderiscolor (some) Metandrocarpa taylori (abun Schizaporella biconiis (much)  Adalaria sp. (some)  Schizaporella biconiis (much)  Noles i dove from Charlies shamook  nice dire much time shallow, some deep, cruised with black rockfish		Chlomys sp. with Mysale Mysalla ( award) Prolus chitamoides (mony)
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Membranipora membranacea (much) Coryphella trilineata (many) Chemidocarpa tinnarkiensis ( Crisia sp (much) Pendronatus delli (tew) Chelyasona productum (some) Bugula colifornica (much) D. Schizaparella bicariis (much) Adalaria sp. (some) Rycnoclavella stanleyi (many) Noles: dove from Charlies shamrack nice dire much time shallow, some deep, cruised with black rockfish	Telephus crispolus (some)	Dirona albolineata (some) Styela gibbiii (some)
Bugula colifornica (much)  D. Oliversicolor (some) Metandrocorga toylori (abun Schizapprella bicomis (much)  Adoloria sp. (some) Rycnoclovella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shollow, some deep, cruised with black rockfish	Pista elongata	Hermissenda crassicornis (some) Bollenia villosa (some)
Bugula colifornica (much)  D. Oliversicolor (some) Metandrocorga toylori (abun Schizapprella bicomis (much)  Adoloria sp. (some) Rycnoclovella stanleyi (many)  Noles: dove from Charlies shamrock  nice dire much time shollow, some deep, cruised with black rockfish	Membranipora membranacea (mu	uch) Coryphella trilineata (mony) Chemidocarpa finnankiensis (tu
Noles: dove from Charlies shamock  nice dire much time shallow, some deep, cruised with black rockfish	Crisia on Conuch)	Deadconolus delli (few) Chelyoson, roductus (com)
Noles: dove from Charlies shamock  nice dire much time shallow, some deep, cruised with black rockfish		P during Garage Metallian Anti-Color
Notes: dove from Charlies shamrock nice dire much time shallow, some deep, cruised with black rockfish		All Carlo
Notes i dove from Charlies shamrock nice dire much time shallow, some deep, cruised with black rockfish	SCHIZEPOTEIL BICOMIS (MUCA)	[ - '' ] [ [ [ [ [ [ [ [ [ [ [ [ [ [ [ [ [
nice dire much time shallow, some deep, cruised with black rockfish	111 . 1 6 61 11	(over)
rice dire much time shollow, some deep, cruised with black rockfish found 2 sinkers, I buzz bomb, I silda		
found 2 sinkers, I buzz bomb, I silda	nice dire much to	ine shollow, some deep, cruised with black rockfish
보다는 워티 대통 모드님께서 되지 않는 생물 보다 되는 점을 모르고 가져있다다.	found 2 sinkers, 1	buzz bomb, I silda
	그는 그림의 기를 드는 함께	나마하를 শુ내림을 다른 다른 그글로 가라다니다.

Figure 1. Handwritten 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.<sup>2</sup> 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.

#### BIODIVERSITY RECORDED BY PACIFIC MARINE LIFE SURVEYS

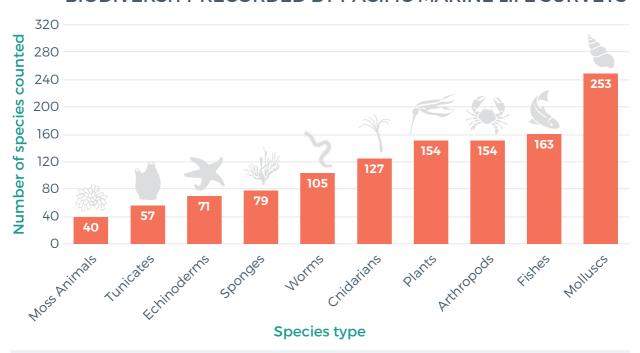


Figure 2. Number of species observed in each of ten taxonomic phyla.



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.

#### NUMBER OF SPECIES OBSERVED EACH YEAR

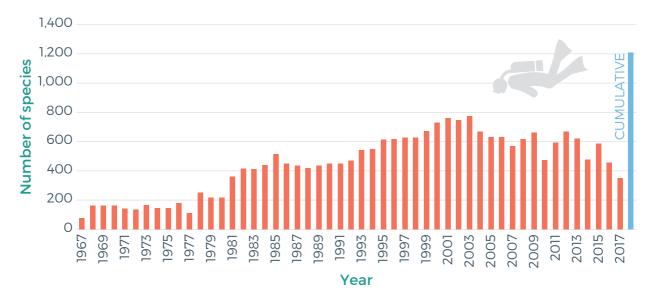


Figure 4. The number of species observed each year varies with the number of dives recorded and with the accumulated experience of the divers. The more experience, the more species identified and recorded. Also, fewer plants were identified in the 1960s and 1970s.

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 experi-

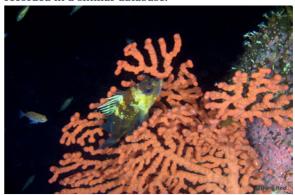
ence, such that the number of species identified per year increased for many years, peaking in 2003, and shows variability since then (Figure 4). For a record of biodiversity, the length of the time series and the geographic extents are rare and valuable. According to the PMLS database, biodiversity (within diving depths) among regions of the B.C. coast does differ.<sup>3</sup> 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 <a href="mailto:Donna.Gibbs@ocean.org">Donna.Gibbs@ocean.org</a>. 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**

<sup>1</sup>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.

- <sup>2</sup> The Marine Biodiversity Project. Accessed February 13, 2018. http://www.vanaqua.org/marine-biodiversity/.
- <sup>3</sup> Marliave et al. 2011



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