Data Gap Analysis for Macrofungi on the California Channel Islands

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August 2021
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I. Scope

This paper provides an overview of the available historical data regarding macrofungi of the California Channel Islands, describes the current patterns of data acquisition, and presents statistics reflecting the cumulative current state of knowledge on this topic. A comparison of some important indicators across the different islands is provided. Near-term and longer-term goals for understanding macrofungal biodiversity on the Channel Islands are established, including actionable, prioritized methods for attaining them.

II. Definitions, abbreviations and terminology

For the purpose of this assessment, *macrofungi* refers to an artificial assemblage of species of fungi that are non-lichenized and which produce macroscopic fruiting bodies. Unless otherwise noted, 'the Channel Islands', 'the islands', and 'the archipelago' refer to the California Channel Islands. Abbreviations used are as follows: ChI – Channel Islands. SMI – San Miguel Island, SRO – Santa Rosa Island, SCR – Santa Cruz Island, ANA – Anacapa Island (three islets treated together), SBA – Santa Barbara Island, SNI – San Nicolas Island, SCA – Santa Catalina Island, SCL – San Clemente Island.

Standardized herbarium abbreviations follow the *Index Herbariorum* (CITE). Numbers preceded by 'iNat' are identifiers for iNaturalist observation records; these can be retrieved by appending the number to the end of the following URL: *www.inaturalist.org/observations/*

III. History of mycology on the Channel Islands

Knowledge of macrofungi on the Channel Islands is remarkably sparse. This ignorance stands in marked contrast to the state of knowledge for lichens on the archipelago: In 2012, four herbaria (ASU, MINN, SBBG, UCR) held > 9,000 collections of lichens from just the four northern islands – representing an astonishing 18% of the lichen collections from all of California held in the same herbaria (Knudsen, 2012). By contrast, despite an additional decade of work and including records from the *entire* archipelago, there are still fewer than 1,000 collections of macrofungi from the Channel Islands represented on MyCoPortal (most of which seem to have been opportunistically collected). The first modern survey efforts focused on macrofungi apparently did not come until the 1980s (Grubisha et. al., 2005). The recent history of survey efforts focused on macrofungi of the Channel Islands is summarized in Table 1.

Before 2000, targeted visits were apparently limited to Santa Cruz Island. At least some of visits included professional mycologists. Between 1960 and 1990, Dr. Harry Thiers (SFSU) was California's foremost macrofungal taxonomist; unfortunately, Dr. Thiers' only visit to the Channel Islands happened to coincide with a severe dry offshore 'Santa

Ana’ wind event, which made for very poor fruiting conditions (Steve Trudell, pers. comm., October 2020). Records from these visits were not publicly available, and most of the associated voucher specimens from these trips were either lost or destroyed by dermestid beetles and mold (Cummings pers. comm., Desjardin, pers. comm., October, 2020; Grubisha, 2005). However, I was able to obtain species lists from Dr. Robert Cummings (who organized most of these trips) pertaining to four trips; they consist of presence/absence data for species encountered by participants as well brief notes on habitat associations and in some cases identification as well. The data represented in these lists has been incorporated into the annotated checklist provided, closing an important existing data gap.

In 2001 and 2002, Lisa Grubisha (then a master’s student) and Dr. Tom Bruns (both UC Berkeley) made a series of intensive survey and collecting visits to Santa Cruz and Santa Rosa Islands, explicitly focused on collecting ectomycorrhizal taxa, especially *Rhizopogon*. These surveys resulted in the first major publications pertaining to Channel Islands fungi: One historical summary and list of species known from the archipelago (Grubisha, 2005), one on the genetic structure of two *Rhizopogon* species on SRO and SCR (Grubisha, 2007), and one paper describing *Suillus quiescens* (Bruns et. al., 2010). At least one of these trips included Dr. Jim Trappe (US Forest Service, Corvallis) – foremost expert on hypogeous fungi in North America. In December 2012, I visited Santa Cruz Island to collect macrofungi with Zach Mikalonis, who had documented a number of notable records for the island as a student in the UCSC Field Quarter program the prior spring. That winter saw abundant precipitation on the northern Channel Islands, and macrofungi were fruiting profusely during our visit. Over the next few years, I investigated some of these collections more thoroughly, incorporating microscopic data and perhaps most importantly, obtaining Internal Trancribed Spacer (ITS) DNA sequence data for many collections. During this time, I visited additional islands and began to familiarize myself with the natural history of the archipelago. In early 2019 I collected and inventoried fungi on San Nicolas Island with the Santa Barbara Botanical Garden, and made a second collecting trip to Santa Cruz Island; on these occasions I was accompanied and assisted by Adam Searcy. Most recently, I visited Santa Cruz Island alone for a short collecting trip in February of 2021.

Date	Main collector(s)	Island
May 1981	John Menge	Santa Cruz
March 1982	John Menge	Santa Cruz
January 1984	Cummings, Thiers, Desjardin, Trudell	Santa Cruz
February 1984	Bob Cummings	Santa Cruz
February 1985	Bob Cummings	Santa Cruz
February 1999	Bob Cummings	Santa Cruz
March 2001	Grubisha and Bruns	Santa Cruz
March 2001	Grubisha and Bruns	Santa Rosa
January 2002	Grubisha and Bruns	Santa Cruz
March 2002	Grubisha and Bruns	Santa Rosa
December 2012	Schwarz and Mikalonis	Santa Cruz
January 2019	Schwarz and Searcy	Santa Cruz
March-April 2019	Schwartz and Schwartz	Santa Cruz
January 2019	Schwarz and Searcy	San Nicolas
January 2019	Schwarz and Searcy	San Nicolas
January 2020	Schwartz and Schwartz	Santa Cruz
February 2021	Schwarz	Santa Cruz

TABLE 1: Macrofungi-focused collecting visits on the California Channel Islands from 1980 – 2021.

iV. Vouchered Records

With respect to macrofungi, Santa Cruz Island is by far the most well-known and well-collected of the Channel Islands; Thanks to its accessibility and greater extent and diversity of native vegetation, it has been an attractive focus for researchers. Including recent targeted visits by the author, approximately 285 specimens of macrofungi from Santa Cruz Island are represented on MyCoPortal. Joanne Schwartz (a community scientist operating in partnership with the Nature Conservancy) has generated an additional ~132 vouchers of macrofungi from Santa Cruz Island in the past two years; these are primarily represented on Mushroom Observer but are not yet represented on MyCoPortal; Some of these collections were DNA-sequenced with support from FunDiS (see the ‘Near Term’ section under Future Directions for more discussion of the role of such organizations in citizen science). The earliest records of fungi on the California Channel Islands are from Santa Catalina Island; although most of the early collections of fungi from SCA are of microfungi, SCA still ranks first among the islands in total number of specimen vouchered macrofungi, with approximately 369 specimens represented on MyCoPortal. However, many of these are of marginally-relevant taxa for the purposes of this analysis (e.g. microfungi that cause macroscopic symptoms on their plant hosts), and most of these collections were made before 1950. A handful were collected by Dr. Brandon Matheny in 2001 (specimens at WTU).

A significant portion of the vouchers supporting the species list in Grubisha, 2005 are held at UC Berkeley – revisiting these specimens to update their determinations with modern identification resources will be a crucial step in advancing the overall ChI mycoflora project – especially those from SRO. ANA is represented by a single vouchered collection, and there are no vouchered macrofungi from SMI, SBA, or SCL represented on MyCoPortal. Balancing this lopsided ratio of vouchered specimens between islands should be a primary determinant of the structure of near-term efforts. Prior to the author's collections with SBBG in 2019, SNI was also represented by a single voucher (less than a week of cumulative surveying turned SNI into one the most-heavily vouchered of the Channel Islands). Macrofungi from SRO currently lack any representation on MyCoPortal – the > 50 specimens made there by Grubisha and others in 2001 and 2002 apparently have yet to be uploaded.

V. Observation records

Despite the aphorism *'without a sequence it's a rumor'* sometimes repeated in academic mycological circles, the exclusion of records that are not sequence or voucher-supported is an excessively conservative and unrealistic approach to understanding biodiversity at scale. There has been a major increase in observation-based records of macrofungi on the Channel Islands over the past decade thanks to community-science platforms. Although there is significant overlap in the lists of vouchered vs. observed-only species, many species are documented only from opportunistic encounters with the use of the iNaturalist mobile app.

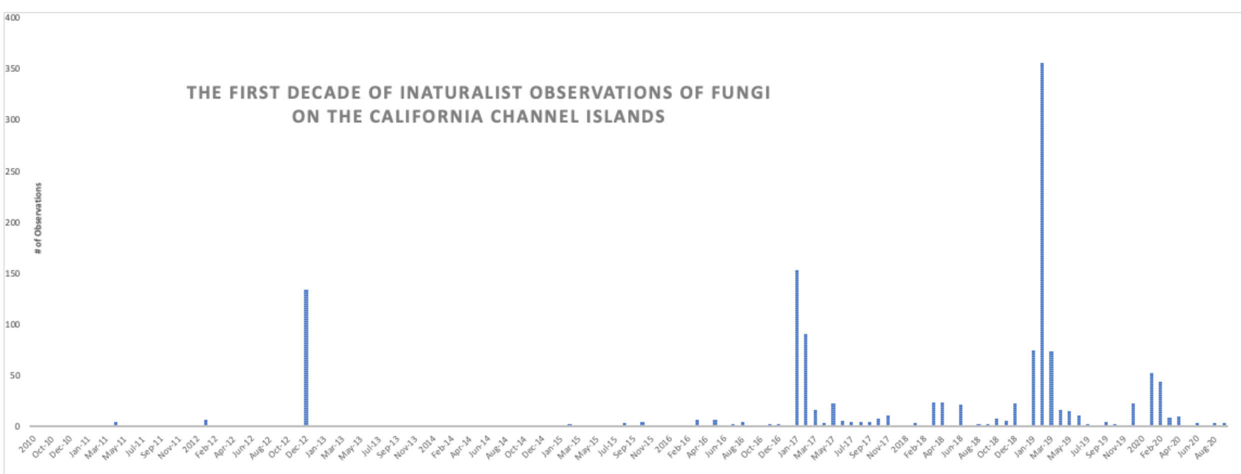

FIG. 1: Timeline of iNaturalist observations of macrofungi on the Channel Islands. The number of observations is becoming marginally more well-distributed over the rainy season with years, but most are still opportunistic. Targeted surveys by 1-2 individuals result in obvious spikes of observations.

VI. Estimating the diversity of macrofungi on the Channel Islands

Fungal biodiversity at large scales has often been estimated by extrapolating ratios of fungal species to plant species within small, well-studied systems. Commonly-cited ratios of fungi to plants vary widely, but of particular relevance to the purposes of this paper, Cifuentes-Blanco et al. (1997) focused on macrofungi in a temperate pine-oak forest. This study arrived at an estimate of 3.5 species of macrofungi for each plant species in this kind of habitat. Given approximately 578 native plants on the northern group of Channel Islands (Knudsen, 2012) a reasonable first estimate for macrofungal diversity across the archipelago might number anywhere from 2,000 – 5,000 species.

Currently, there are ~ 475 macrofungal taxa known from the California Channel Islands (see Annotated Checklist in Appendix).

As a comparison, the mainland county of Santa Cruz is the second smallest county in California by area (1,570 km^2). A decade of the author's own intensive surveying of this county's macrofungi have been augmented via the iNaturalist community science platform – contributions from more than 2,000 participants have yielded a combined total of > 30,000 observations representing 1,150 species at time of writing. Despite being slightly less than twice as large as the total area of the Channel Islands (and even when taking only iNaturalist data into account), Santa Cruz County is about 14 times as densely-sampled for macrofungi as the aggregated Channel Islands (approximately 21.3 observations / km^2 vs. 1.5 observations / km^2, respectively) when using iNaturalist data as a proxy for effort.

Island	Land Area (km^2)	Annual Rainfall (mm)	Species	Specimens	Observations	Observers	Species / observer	Observations / km^2	Species / km^2
Santa Cruz	250	415	291	285	466	54	5.4	1.86	1.16
Santa Rosa	215	287	40	0	17	7	5.7	0.1	0.19
Santa Catalina	192	304	128	369	515	41	3.1	2.7	0.67
San Clemente	147	203	40	0	191	12	3.3	1.3	0.27
San Nicolas	59	203	69	169	189	6	11.5	3.2	1.17
San Miguel	38	406	3	0	4	1	3.0	0.1	0.08
Anacapa	2.8	223	4	1	7	2	2.0	2.5	1.43
Santa Barbara	2.6	229	2	0	6	2	1.0	2.3	0.77

TABLE 2: Comparison of land area, precipitation, vouchered specimens, species-level diversity of macrofungi and roughly-estimated community-science survey effort across the Channel Islands. The right-most five columns represent only the iNaturalist data for the purposes of approximating modern survey effort. See Appendix for full representation of species-level diversity including other platforms and collection-based records. For integer data, warmer hues represent higher values, while ratios are represented on a single-hue scale where higher values are more saturated.

Although none of the islands can be characterized as well-sampled, the observations/km^2 figures for Santa Rosa and San Miguel indicate striking data deficiencies. Santa Rosa in particular seems to be disproportionately under-surveyed since it does not suffer from the same degree of access-restriction as San Miguel, and supports extensive habitat suitable for rich macrofungal communities.

Finding, documenting, and identifying macrofungal diversity on the Channel Islands in a reasonably near-term time frame will necessitate a major, coordinated increase in effort.

VII. Introduced, Listed, Endemic, and Undescribed Taxa

Introduced and Invasive species

Questions about the introduced vs. native status of macrofungi on the Channel Islands are difficult to answer with quantitative evidence given the total lack of baseline data prior to widespread human disturbance. However, strong hypotheses can be based on observational and anecdotal evidence relating to hosts, relationship to disturbance, and mainland trends.

Amanita phalloides is a deadly toxic ectomycorrhizal gilled mushroom introduced to California from Europe. It is now extremely widespread and invasive on the mainland Pacific Coast, but remains rare (notably, not entirely absent) on the Channel Islands. Monitoring the continued rarity or eventual spread of this species on the ChI will be of great value for our understanding of the invasion biology of this species (and by extension, for invasion biology of ectomycorrhizal fungi in general).

A number of presumably anthropogenically-introduced but non-invasive ruderal species are found on the ChI. These are mostly decomposers of woodchips or generalist saprobes in other nutrient-rich, disturbed sites. Although likely native to the islands, a number of species are probably significantly more abundant than before human habitat alteration (e.g. *Laetiporus gilbertsonii* on introduced eucalyptus).

Listed taxa

There are no non-lichenized macrofungi with Endangered status at either the state (CA) or Federal Level. Consequently, none are known to occur on the Channel Islands. The only species IUCN Red-listed species known to occur on the ChI is *Dictyocephalos attenuatus*, but there are almost certainly additional species of conservation concern – especially any species eventually established as being endemic to the ChI. Substrate-specialist decomposers (e.g. decomposers of *Leptosyne*), host-specific parasites (e.g. polypores on *Lyonothamnus*), and ECM symbionts of island-endemic trees and shrubs (*Quercus tomentella*, *Arctostaphylos* spp.) are the most likely ecological guilds to which such species might belong.

Endemic taxa

One of the primary questions regarding macrofungi on the Channel Islands is whether there are any bonafide island-endemic taxa. The primary means for making such determinations will be parallel mass-sequencing efforts of macrofungi on the island and the mainland followed by taxonomic publications directly comparing vicariant species pairs. It is most likely that such taxa will be found among substrate-specific saprobic or host-specific mycorrhizal guilds.

Undescribed taxa

There are no doubt many undescribed macrofungi on the Channel Islands, but this is primarily due to the relatively undeveloped state of macrofungal taxonomy in California and the United States in general. Although descriptions of new species from the islands provide ideal narratives for publicity and communicating research progress, their discovery and publication should be seen as a natural corollary outcome of assembling a mycoflora for the islands, rather than as a primary goal.

VIII. Goals for the next five years

Near-term efforts should first and foremost be directed towards generating a high volume of observations, with an emphasis on achieving habitat coverage, and consolidating information into 'infrastructure' for use by multiple kinds of researchers.

Goal 1: Generate reasonably complete first-pass species lists for each of the Channel Islands

The concept of 'coverage' in this context is not strictly (or even primarily) about broad or well-distributed *spatial* coverage of the islands, but rather to capture a sense of species turnover (beta diversity) in relation to biotic and abiotic drivers which are covariant over geographic space. As such, simply increasing the total area surveyed is less useful for achieving this goal than targeting significantly *different* areas. For each island, effort should be made to devote sampling time to each habitat present – in particular, visits to patches of each ectomycorrhizal plant host present on the island should be made. Specialized symbiotic relationships of this kind are major drivers of community composition, and even if the spatial extent of the habitat is very small proportional to the island's overall area, it may account for a significant proportion of the fungal diversity of the island.

On the mainland, such goals are often pursued by organizing 'bioblitzes' during which many participants make observations during a limited time period (often a single-day).

This can be thought of as ‘many-participants, limited time’ model – which is often the most convenient organizational strategy under normal constraints.

In the case of macrofungi on the ChI, an inverted effort structure is a better strategy: The short duration of macrofungal fruiting is compounded by the fact that this season occurs during the part of the year in which the already-limited accessibility of the islands is often hampered by storms bringing rain, as well as high winds and seas: Boat and plane trips are often delayed or postponed entirely, and dirt roads on the islands often become undriveable. Organizing visits by a smaller number of more-experienced observers able to cover larger areas during visits lasting 5-7 days is much less logistically demanding than organizing bioblitzes. This is especially true given the need to negotiate and obtain access to non-public areas (not least those that require unexploded ordinance trainings or military clearance) – this process is much more tractable for a few individuals as opposed to the dozens typically involved in bioblitz-style data gathering.

Even aside from these access challenges, species-accumulation curves for macrofungi tend to take a long time to saturate compared to other terrestrial eukaryotic taxa, making distributed models of data gathering a crucial component of long-term efforts to fully document the biodiversity of the Channel Islands. To facilitate this mode of data gathering, the SBBG can help by cultivating of a pool of interested and empowered island visitors and equipping them with simple, adaptable protocols will allow them to better take advantage of short fruiting windows during unpredictable and infrequent high-rainfall years.

Organizers can create narrativized ‘challenges’ to the broader community to shape the focus, motivations, and data-gathering habits of participants. As always, this should be followed by timely reporting about results and findings back to participants; the community science model requires a bidirectional flow of information. Prizes, recognition, and other incentives can be thoughtfully implemented to drive participation and encourage higher-quality data. Such initiatives can be nimbly run on a combination of platforms – iNaturalist for data aggregation paired with Facebook and Instagram for outreach and reporting of results.

Goal 2. Assemble basic biodiversity portraits for all species

Each species added to the ChI mycoflora list should be associated with 6 pieces of information that together constitute a ‘biodiversity portrait’.

1. **Photographs** – This is no more complicated than assembling a repository of reliably-identified photos of fruitbodies for each species. Having this resource

enables much more rapid taxonomic progress and facilitates field surveys – it can be considered biodiversity ‘infrastructure’. Rather than reinventing the wheel, this repository can be assembled using iNaturalist, with the added step of an ID-curated subset drawn from this pool. Although photo-documentation is extremely easy (even smartphone photos are usually more than adequate for this purpose), the extra step of labeling taxonomist-vetted benchmark photos is an important additional step – observations that have received this kind of attention should be explicitly labeled as such in iNaturalist, and in whatever future print or web resources are assembled to further this goal.

2. **DNA sequences** – Sequencing efforts and resources should be frontloaded: Specimens should be sequenced as they become available without much discrimination or selectivity. If funding is not extremely constrained, additional sequences per species (especially in difficult groups where cryptic taxa are common) are also valuable. Collections should be sequenced as soon after they are collected as possible and then rapidly made available. Well-known taxa (although all species on the islands should be ideally be represented by at least one sequence) can be deprioritized to extend limited financial resources. It will be critical to maintain an island-specific database of sequences to allow for efficient comparison of newly-sequenced specimens to those already collected from the island. Crucially, sequences should be obviously and explicitly linked to relevant metadata (this is usually inexcusably lacking from GenBank records). The simplest and most effective way to accomplish this is by embedding an associated iNat number with sequence files: iNat observations are updatable, searchable, and serve to neatly link images, location, date, discussions, and virtually any other type of associated data desired.

3. **Ecology and Life History –** Understanding the ecological interactions and life history strategies of species is a long-term goal of any mycofloristic project (or any other biodiversity inventory). Knowing the names of each species allows researchers to communicate efficiently about them – but what it is they are *doing* is the real matter of interest. The interweavings of interaction between plants, invertebrates, soil microbes, and fungi are complex enough that we should expect their unraveling to take decades. By sketching at least rough outlines of what we currently understand about the lives of macrofungi, we can begin to see more complete pictures of these island ecosystems, and structure research questions around them.

4. **'Q-data' –** Quantitative data, or 'Q-data' refers to any aspects of a species that are not clearly visible to unaided human senses. Most immediately, this refers to micromorphology: Spore size and shape, cellular ornamentation, etc. It might also include quantified chemical profiles (concentration of interesting biomolecules), for example. These 'closer-look' details are harder to obtain, since they require more sustained attention and equipment, but will provide crucial insights into the origins of island-biogeographic patterns of macrofungi, as well as the consequences of insular evolution on their physiology.

5. **Distribution –** Fine-scale occurrence maps of species are of great 'biodiversity infrastructure' value – they provide almost-literal roadmaps for researchers investigating questions that require locating individual species or clades. This is especially important for obligate symbiotic relationships – the kind that macrofungi form with a range of other taxa, from bacteria to lepidoptera to (perhaps most notably) plants. Although randomized transects can be useful to minimize sampling biases (especially to establish the true extent of occurrence of inconspicuous species), this goal will be well-served by opportunistic data acquisition for the foreseeable near-term (especially if sheer volume of observations is encouraged). As such, accomplishing this goal likely does not need any special additional focus, but rather will emerge from routine data gathering.

6. **Phenology –** Like distribution maps, phenology charts are assembled in an automated manner on iNaturalist. Likewise, assembling temporal occurrence data should be seen as an emergent outcome of opportunistic / unstructured surveys generating large volumes of observation data. This is not to diminish the value of such data: Shifting phenological patterns are among the most important areas of investigation to describe the effects of a changing climate. If and when resources are available to do so, more standardized, rigorous efforts will help to diminish sampling bias in this phenological dataset (perhaps more important in the case of macrofungi on the Channel Islands because of inconsistent access).

Online publication of an annotated checklist incorporating all six aspects of these biodiversity portraits will serve as infrastructure for ecological and evolutionary research.

Such a checklist will help more-casual visitors determine whether new finds represent significant records in need of vouchering, and will provide a fundamental data product needed for a variety of more-complicated research questions.

IX. Longer-term (10+ year) Goals

Foster opportunistic data acquisition by island biologists a standard practice

Field biologists working on other taxa (ornithologists, entomologists, botanists) often live on the ChI for extended periods spanning one or more seasons (including on the difficult-to-access Navy-owned islands). These field workers should be introduced to the use of the iNaturalist app and strongly encouraged to submit observations of macrofungi freely, stressing that even occasionally making such observations has the potential to amount to a significant contribution to our knowledge. The effect of an observer opportunistically documenting macrofungi can be dramatic: A single plant restoration worker living on SCA contributed 28% of iNaturalist observations of macrofungi on the ChI at the time of writing (see Table 2)!

Determine endemicity of ChI macrofungal taxa

Intensive surveying, collecting, and sequencing of macrofungi on the ChI will doubtlessly generate a significant number of difficult identification problems. These will include taxa from inherently difficult groups (*Cortinarius*, *Inocybe*, etc.) and taxa from groups with complicated nomenclatural histories, as well as species that are entirely undescribed. Recruiting a team of taxonomists (with support from phylogenetic and nomenclatural experts) and focused specifically on resolving such taxonomic issues as they emerge from ChI data would speed up the knowledge-building process as well as making it more thorough.

Assemblages of macrofungi associated with *Adenostoma*, *Comarostaphylis*, *Cerococarpus*, and *Quercus tomentella* seem likely to remain poorly known due to their often-unfavorable fruiting environments; soil and root tip sequencing may help fill in these biodiversity data gaps, although it should be noted that the assemblage of species detected during aboveground surveys is often significantly non-overlapping with the species recovered purely by soil sequencing in the same areas (CITATION).

Involve the broader community in long-term monitoring and conservation

Community colleges (and even high schools) should be encouraged to create thematic content around Channel Islands macrofungi, and local universities (e.g. CSU Channel Islands) should create openings for graduate students to center ChI macrofungi in their research; this system is complex and varied enough accommodate many kinds of research.

X. Distribution Maps of iNaturalist Observations of Macrofungi by-island
Santa Cruz Island

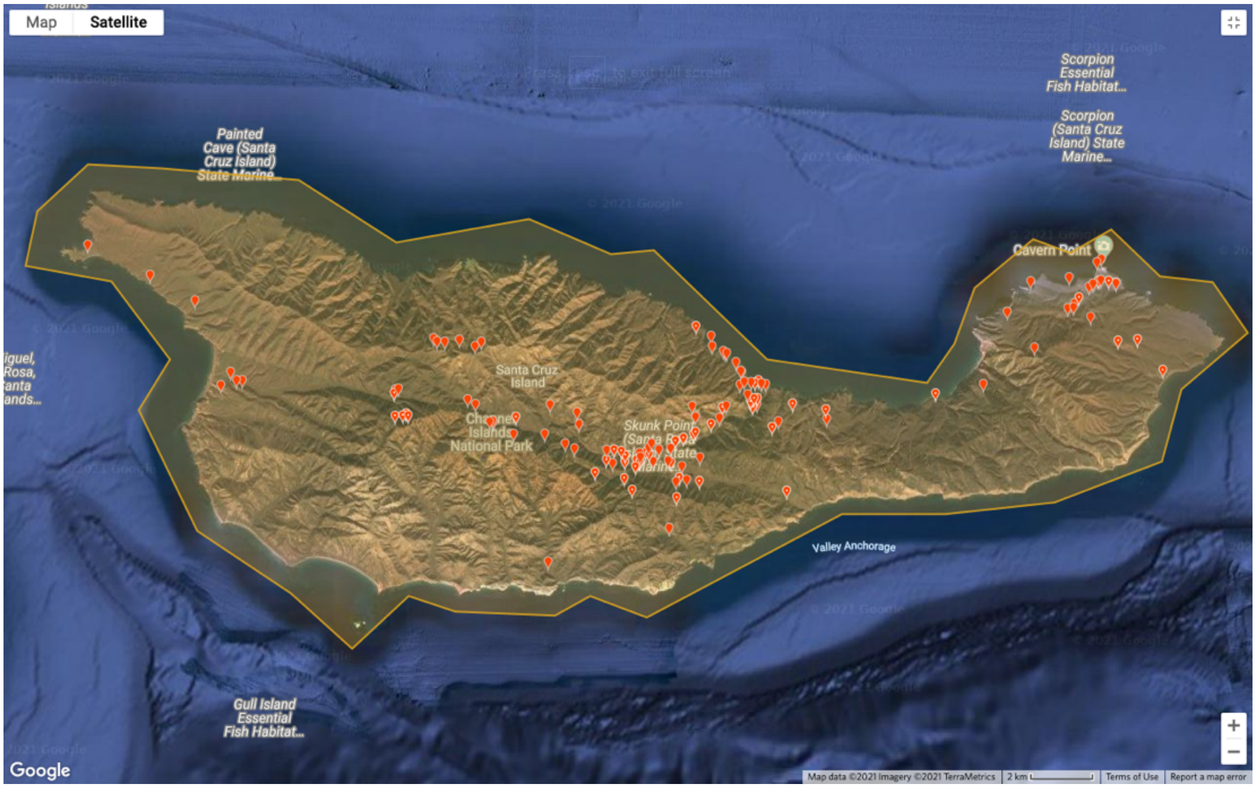

Fig. 2 Santa Cruz Island has received by far the most specialized attention of any of the islands, but remains somewhat under-covered due to its large size and rugged terrain (with minimal road access). Coordinating surveys to balance this effort across the island will take significant strategizing, given that the fruiting season for macrofungi usually coincides with the least-favorable road conditions.

Santa Rosa Island

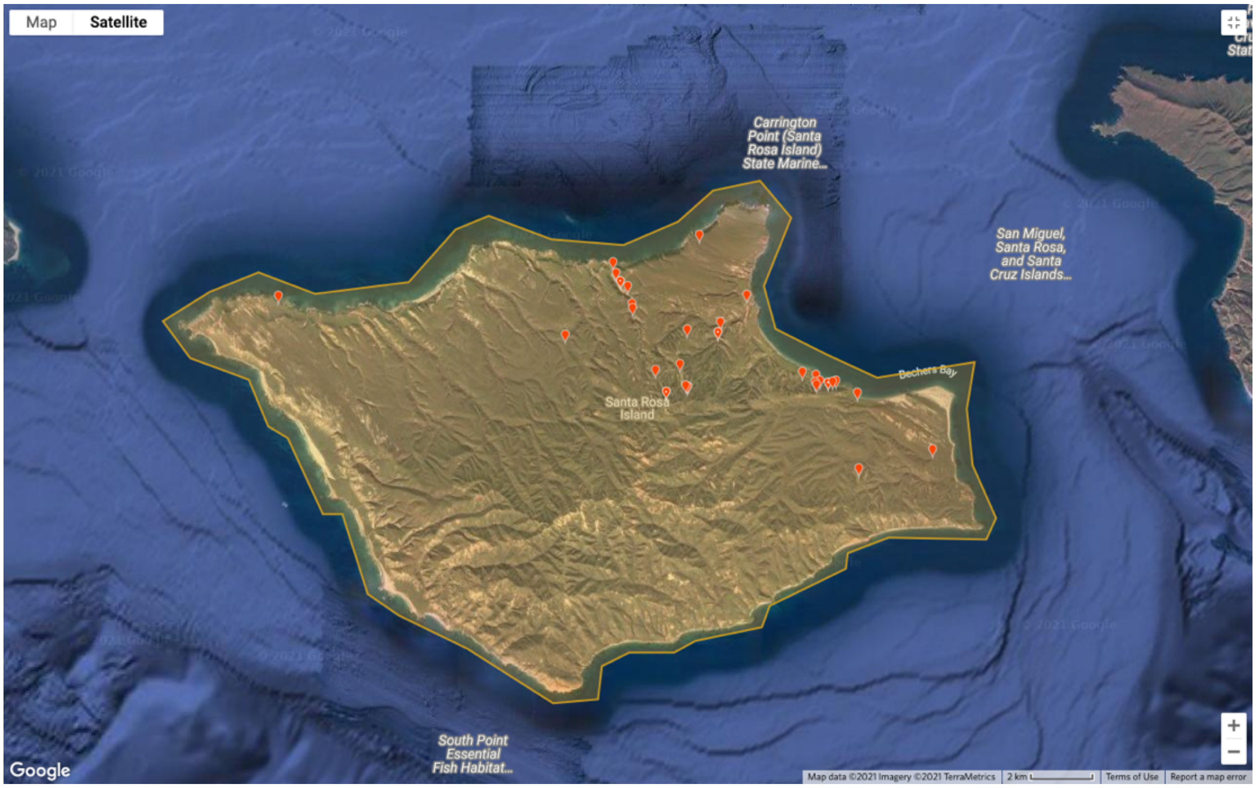

Fig. 3 Santa Rosa Island represents a large data gap (although coverage is better than the iNaturalist map points suggest, since Grubisha et al. visited and vouchered specimens, although these are not yet represented on MyCoPortal). For future visits, focus should remain on the more vegetated, damp, sheltered canyons on the north side of the island. Much of the rest of the island is heavily degraded by grazing and subsequent erosion, and thus unlikely to contribute significantly to the overall species list of macrofungi. The Torrey Pine groves have yet to be extensively surveyed during optimal fruiting conditions and are likely to support the most distinctive macrofungal community on the island.

San Clemente Island

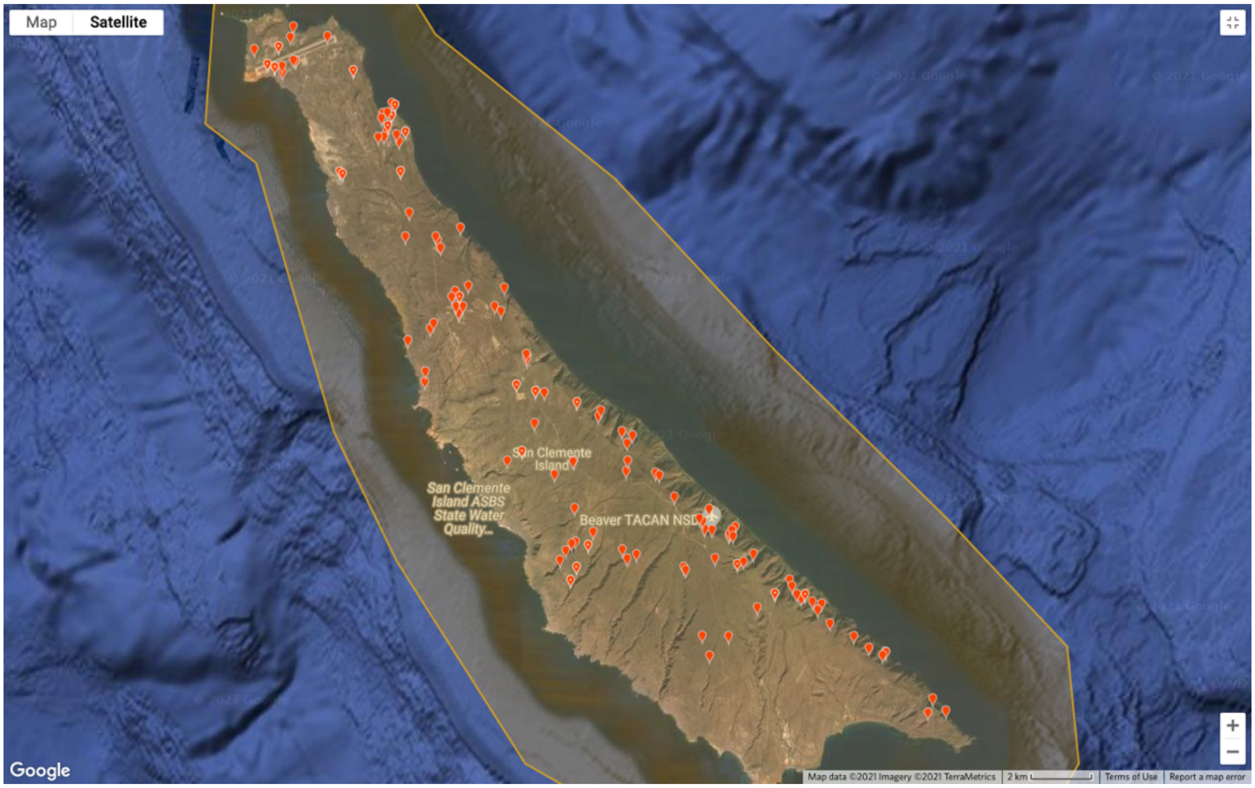

Fig. 4 Santa Clemente Island has had the benefit of permanent population of biologists who submit relatively large volumes of opportunistic observations. As such, it enjoys good coverage, although by non-specialists, and thus reflecting only the more common and conspicuous elements of macrofungal diversity.

Santa Catalina Island

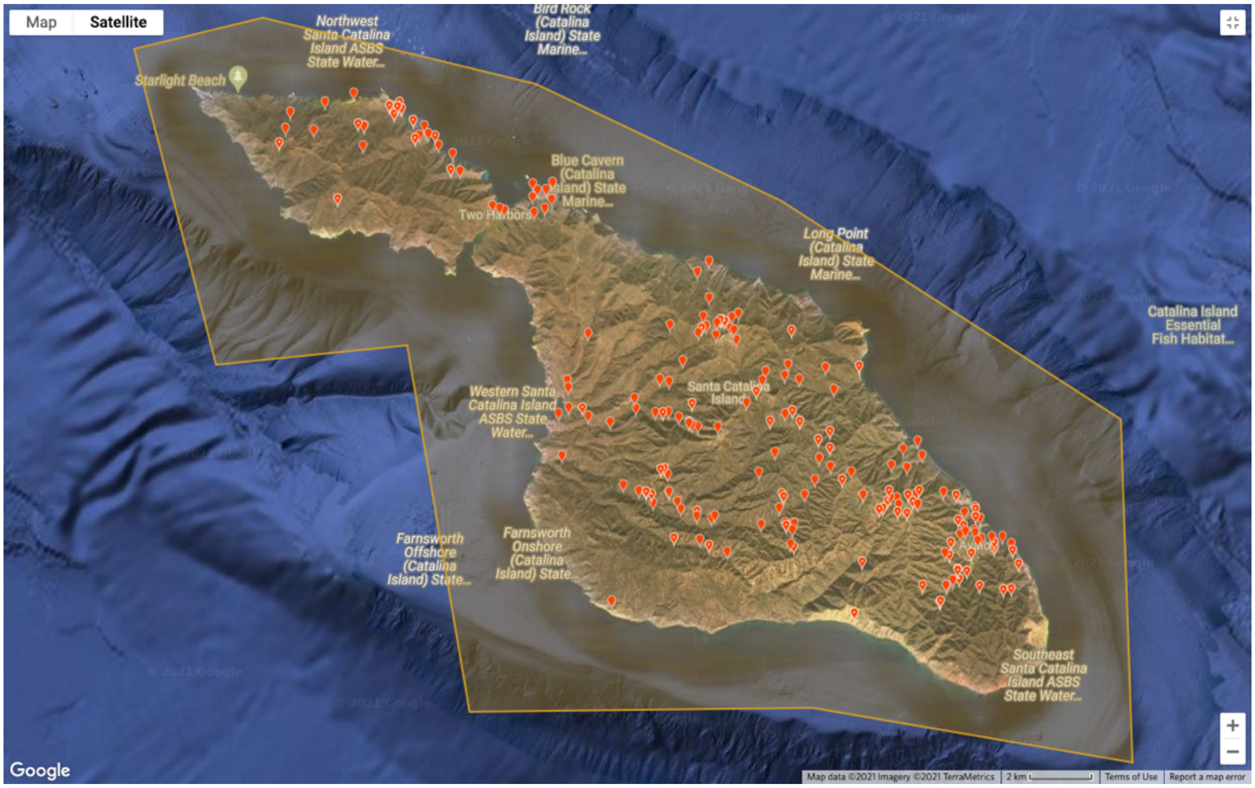

Fig. 5 Santa Catalina Island is easily the most geographically well-covered island in the ChI Archipelago due to the presence of year-round botanical workers who make incidental observations of macrofungi using iNaturalist. However, virtually none of these observations were made by specialists in macrofungi, thus resulting in overrepresentation of common and conspicuous species and a comparatively low species/observation ratio.

Anacapa Island

Fig. 6 Despite its small size, Anacapa Island faces extreme geographic coverage challenges. The Middle and West Anacapa Islets are virtually impossible to survey; compounded by the fact that they are distinctly different in both biotic and abiotic conditions compared to East Anacapa, this means our understanding of this island will likely always be least data-deficient.

San Nicolas Island

Fig 7. San Nicolas Island provides an example in which geographic coverage has been relatively limited, but in which coverage of *habitats* is good – two focused visits by specialists resulted in extensive surveying of all of the island's representative habitats, and even captured species turnover between sites (two different *Salix* groves, multiple patches of *Pinus*, multiple *Leptosyne* groves, multiple grassland sites, etc.).

Santa Barbara Island

Fig. 8 Santa Barbara Island is tiny, with very little suitable habitat for rich communities of macrofungi. A single visitor could fully survey the entire land area in a single day. As such, it should prove to be the island for which the species-accumulation curve is most immediately saturated.

San Miguel Island

Fig. 9 By any metric, San Miguel Island is still the most poorly-covered island with respect to macrofungi. Admittedly, very little of the island's area can be considered favorable habitat. Nonetheless, a single productive wet-season visit should be expected to greatly increase the number of macrofungal species known from the island.

XI. References

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