CHAPTER 4. CRYPTOGENIC AND UNIDENTIFIED SPECIES IN THE SAN FRANCISCO ESTUARY

Numerous species of marine plants and animals occur in the San Francisco Estuary whose status as introduced or native organisms remains unknown. These taxa are known as cryptogenic species (Carlton, 1995). We list here examples of 123 such taxa (Table 2). Many additional unidentified or taxonomically unresolved marine protists and smaller invertebrates exist in the Bay's estuarine margins as well and are not treated here. These include, in particular, roundworms (nematodes), flatworms (turbellarians), rotifers, harpacticoid copepods, and many species of planktonic and benthic ciliate protozoans. These unidentified taxa (representing at least an additional 25 distinct morphological entities), including members of groups also commonly occurring on oyster shells and in ballast water, are often found abundantly amidst communities dominated by species recognized as introduced. Most of the species listed in Table 2 represent one or more of the following categories:

1) Species frequently reported from fouling communities or planktonic assemblages in many cool- to warm-temperate harbors and ports around the world and which represent taxa easily transported with oysters, in ship fouling, in solid ship ballast, in ballast water, or by other means.
2) Species whose estuarine populations may represent a different species from populations occurring on outer, high-energy, full marine coasts that bear the same name.
3) Species believed to have appeared relatively recently in the Estuary.
4) Species symbiotic with known introduced species.

The taxonomy and distribution of the taxa listed as cryptogenic usually remain sufficiently unresolved as to prevent a clear resolution of their endemic versus exotic status without further data. In some cases, a species name is available; in other cases, only generic assignments are possible but enough evidence is at hand to question whether the taxon can automatically be considered native. In a number of cases (e. g. diatoms and other phytoplankters; hydroids) we have chosen examples of genera within which one or more (and sometimes many) species have been reported from the Estuary that represent cosmopolitan taxa potentially transported by human dispersal vectors and whose aboriginal history in the Eastern Pacific has not yet been worked out.

It is worth noting that cosmopolitan species represent one of three biogeographic categories: (1) a single species with truly broad and/or disjunct distributions achieved by natural means, (2) a single species spread by human-mediated transport, or (3) multiple species described as a single species. Combinations of these categories may complicate this trichotomy. Thus, one or more species may be spread globally by a mixture of natural and human-mediated mechanisms, creating a complex intermingling of pure and hybrid populations which are then described as a single cosmopolitan species.

The importance of recognizing cryptogenic species in elucidating potentially profound changes to the environment is discussed in Chapter 6. As noted there, no introduced diatoms, dinoflagellates, or other phytoplankters (such as chlorophyceaens, chrysophyceaens, cryptophyceaens, or cyanophyceaens) have been recognized from the Bay, despite a reported flora that includes many cosmopolitan taxa.

Prominent cryptogenic guilds in the Bay include phytoplankton (25 percent), annelid worms (19 percent), protozoans (15 percent), and cnidarians and crustaceans (about 10 percent each).

Table 2. Cryptogenic Species in the San Francisco Estuary

Names of genera listed without species indicate at least one cryptogenic species. Names of genera followed by "spp." indicate at least two cryptogenic species.

[+] indicates San Francisco Bay populations, distinguished from open coast populations bearing the same name

MICROALGAE

Bacillariophyceae (Diatoms)
- *Achnanthes*
- *Asterionella*
- *Aulacoseira* (= *Melosira*) spp. (including *A. distans* var. *lirata* and *A. granulata*)
- *Biddulphia* spp.
- *Chaetoceros* spp.
- *Coscinodiscus* spp.
- *Cyclotella* spp. (including *C. caspia*)
- *Navicula* spp.
- *Nitzschia*
- *Pleurosigma*
- *Rhizosolenia*
- *Skeletonema* (including *S. costatum* [+])
- *Thalassiosira* (including *T. decipiens*)
- *Thalassiothrix*

Dinophyceae (Dinoflagellates)
- *Dinophysis*
- *Gonyaulax* spp.
- *Gymnodinium*
- *Protoperidinium* spp.

Chlorophyceae
- *Monoraphidium*
- *Scenedesmus*

Cryptophyceae (Microflagellates)
- *Chroomonas minuta*
- *Cryptomonas*

Cyanophyceae (Blue-Green Algae)
- *Anabaena*
- *Oscillatoria*

Table 2. Cryptogenic Species - continued

MACROALGAE (Seaweeds)
Chlorophyta (Green Algae)
Cladophora
Enteromorpha "intestinalis" [+]
Enteromorpha spp.
Ulothrix
Ulva "lactuca" [+]
Rhodophyta (Red Algae)
Gigartina sp.
Gracilaria verrucosa
Grateloupia doryphora

VASCULAR PLANTS
Dicotyledones
Myriophyllum sibiricum
Polygonum amphibium

PROTOZOANS (examples only)
Epizoic or endozoic ciliates
Acineta sp. (on the introduced gribble isopod *Limnoria*)
Ancistrumina kofoidi (in the introduced clam *Petricolaria*)
Ciliate A (in the introduced shipworm *Teredo navalis*)
Ciliate B (in the introduced shipworm *Teredo navalis*)
Ciliate S1 (on the introduced isopod *Sphaeroma quoyanum*)
Ciliate S2 (on the introduced isopod *Sphaeroma quoyanum*)
Cochliophilus depressus (in the introduced snail *Ovatella*)
Cochliophilus minor (in the introduced snail *Ovatella*)
Epistylis sp. (on the introduced gribble isopod *Limnoria*)
Opercularia sp. (on the introduced gribble isopod *Limnoria*)
Vorticella spp. (on the introduced gribble isopod *Limnoria*)
Fouling ciliates
Suctorian sp. A
Vorticella sp.
Zoothamnium spp.
Free-living Benthic/Fouling ciliates
Spirorhynchus verrucosus
Planktonic holotrich ciliates
Mesodinium rubrum
Foraminifera
Ammobaculites exiguus
Milammina fusca

Table 2. Cryptogenic Species - continued

INVERTEBRATES
Porifera
Scypha sp.
Rotifera
Synchaeta bicornis
Cnidaria
Hydrozoa (examples only)
Bougainvillia ramosa
Campanularia
Clytia
Cryptolaria pulchella
Gonothyraea
Plumularia
Sarsia spp.
Sertularella
Sertularia
Syncoryne eximia
Anthozoa
Nematostella vectensis
Metridium senile [+]

Platyhelminthes
Trematoda
Austrobilharzia variglandis
Turbellaria
Childia groenlandica
Nemertea
Lineus ruber
Annelida
Oligochaeta
Aulodrilus limnobius
Bothrioneurum vejdovskyanum
Limnodrilus hoffmeisteri
Limnodrilus udekemianus
Polychaeta
Capitella spp.
Cirratulidae, unidentified species (*"Tharyx parvus"* of Bay authors)
Ctenodrilus "serratus"
Eteone californica/Eteone longa complex [+]
Euchone limnicola
Exogone "lourei"
Fabricia sp.
Glycera dibranchiata [+]
Glycinde sp.
Harmothoe imbricata [+]
Nereis virens [+]

Table 2. Cryptogenic Species - continued

Polychaeta - continued
- *Ophryotrocha puerilis*
- *Polydora socialis*
- *Prionospio pinnata* [+]
- *Pygospio elegans* [+]
- *Spiophanes "bombyx"* [+]
- Spirorbidae, unidentified species
- *Typosyllis* sp.

Arthropoda: Crustacea

Copepoda
- *Eurytemora affinis*
- Notodelphyoid species (commensal in the introduced seasquirt *Molgula*)

Cumacea
- *Cumella vulgaris* [+], in part: estuarine populations

Tanaidacea
- *Leptochelia dubia*

Amphipoda
- *Caprella "equilibra"* [+]
- *Caprella "penantis"* [+]
- *Grandifoxus grandis* (= *Paraphoxus milleri* of San Francisco Bay authors)
- *Hyale* sp.
- Ischyroceridae, unidentified species
- *Listriella* sp.
- *Photis* sp.
- *Synchelidium* sp.

Arthropoda: Insecta
- *Prokelisia marginata* (on the introduced cordgrass *Spartina alterniflora*)

Bryozoa
- *Alcyonidium parasiticum*
- *Aspidelectra* sp. (?)
- *Conopeum reticulum*
- *Electra crustulenta* [+], in part: estuarine populations
- *Membranipora* sp. (?)
- *Smittoidea* sp.

Chordata: Tunicata
- *Botryllus "tuberatus"* [+]
- *Didemnum* sp.