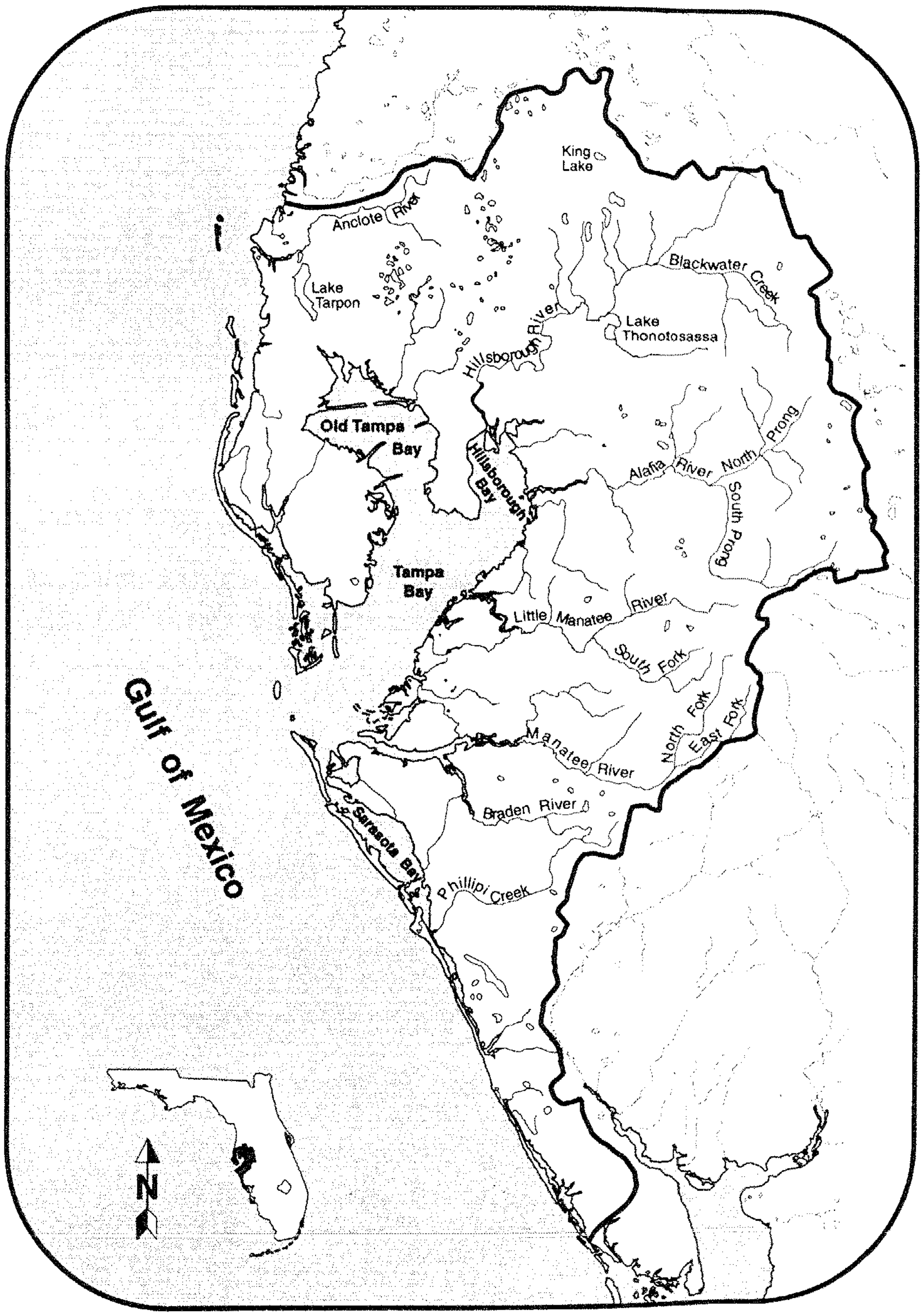
Biological Report 90(20)
December 1990

An Ecological Characterization of the Tampa Bay Watershed



Fish and Wildlife Service and
Minerals Management Service

U.S. Department of the Interior

Chapter 6. Fauna

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6.1 Introduction

Generally speaking, animal species utilize only a limited number of habitats within a restricted geographic range. Factors that regulate habitat use and geographic range include the behavior, physiology, and anatomy of the species; competitive, trophic, and symbiotic interactions with other species; and forces that influence species dispersion. Such restrictions may be broad, as in the case of the common crow, which prospers in a wide variety of settings over a vast geographic area; or narrow as in the case of the mangrove terrapin, which is found in only one habitat and only in the near tropics of the western hemisphere. Knowledge of animal-species occurrence within habitats is fundamental to understanding and managing fish and wildlife resources. Consequently, the major thrust of our discussion of the fauna of the Tampa Bay watershed is concerned with documenting which animal species tend to occur in which habitats. Lewis and Estevez (1988) have a much more thorough examination of the marine aspects of the area in their estuarine profile of Tampa Bay.

It would obviously also be useful to know how, when, and why a particular habitat is used by a given species. At what life stage(s) does the animal use a given habitat and for what purpose (i.e., nesting, reproduction, feeding, roosting, aestivation, as pupae, larvae, juveniles or adults)? Is habitat use continuous by one or another species or is it restricted to certain seasons, certain times of the day, or only certain sublocations within the habitat (e.g., canopy, tree bark, soil litter, benthos, plankton)?

Though these details may be essential to the management of a species, the lack of this knowledge on each species, as well as the limited scope of this document, often excludes such information from our discussion. Where possible, references to more detailed information on local fish and wildlife conditions are included.

6.2 Invertebrates

6.2.1 Freshwater Invertebrates

Data on freshwater invertebrate communities in the Tampa Bay area are reported by Cowell et al. (1974) in the lower Hillsborough River; Cowell et al. (1975) in Lake Thonotosassa; Dames and Moore (1975) in the Alafia and Little Manatee Rivers; and Ross and Jones (1979) at numerous locations within the basin. Selected species or higher taxa that have been studied include the freshwater grass shrimp *Palaemonetes paludosus* (Beck 1974); the mayflies (order Ephemeroptera) (Berner 1950); the dragonflies (order Odonata) (Beyers 1930); and the water beetles (order Coleoptera) (Young 1954).

Other invertebrate studies, though not occurring within the basin, should also be noted. They are useful because of their proximity to the study area and the similarity of the ecological processes investigated on area water bodies. Such studies include those of Lanquist (1953) and Ware and Fish (1969) in the Peace River Basin following phosphate slime spills. Important plankton studies in nearby systems were made by Maslin (1969), Reid and Blake (1969), Nordlie (1976) and Shireman and Martin (1978).

Cowell et al. (1974) sampled five stations in the lower Hillsborough River for invertebrate fauna, each station having a mixture of bottom types, vegetation, physical environments (pools, ponds, runs), and resulting current structures. Of the 143 taxa recorded, 122 were insects, with Diptera (32 taxa), Odonata (28 taxa), and Coleoptera (26 taxa) being the most common orders. In quantitative benthic samples, oligochaetes, mollusks, and chironomids account for 37.6%, 32.6%, and 25.7% of the total fauna, respectively. Densities in this study range from 25 to 3,303 organisms/m^2.

Similar numbers of taxa (49–52) were recorded at the four river stations, with many taxa occurring at more than one station. Samples taken in a *Sphagnum* bog off the river yielded 25 taxa, 13 of which were found nowhere else in the river system. In general mayflies, mollusks, and dragonflies (Odonata) were more numerous at upstream swamp forest stations, while damselflies (Odonata) and chironomids (Diptera) were more abundant downstream, especially in vegetation. As in the Peace River, the introduced pelecypod mollusk *Corbicula manilensis* was abundant in the Hillsborough River. *Corbicula* is also abundant in the upper reaches of the Manatee River estuary (Culter and Mahadevan 1982).

The effect of vegetation on invertebrate densities, though difficult to compare quantitatively, is quite apparent in the data. Cowell et al. (1974) estimated a 10- to 100-fold greater density of organisms collected in vegetation than in benthic samples. In the *Egeria-Hydrilla* community, Beck (1974) estimated 3 x 10^5 to 11 x 10^5 grass shrimp per hectare, and Barnett (1972) estimated 2 x 10^5 to 4 x 10^5 mostly forage fish per hectare. These values are 2 to 3 orders of magnitude higher than values from adjacent areas with no vegetation.

The species composition of the communities varies as well. In the shaded, fast-flowing reaches of the upper river, the *Vallisneria* grass-bed community is an important source of invertebrates serving as food for fish. Areas dominated by *Ludwigia* and *Polygonum* also showed high densities of invertebrates, while *Pontederia* and *Paspalum* contained relatively few taxa and lower densities.

Cowell et al. (1974) reported a zooplankton community in Lake Thonotosassa dominated by small-bodied herbivores. A total of 23 species of rotifers, 5 of copepods, and 6 of cladocerans are recorded. Species diversity was lowest in January, August, and September. Of the six cladocerans, *Bosmina longirostris* was the most common, comprising 93% of the total.

Rotifers were the only group to exhibit significant horizontal spatial patchiness in species composition. This patchiness correlated well with increasing water depth. At the same time, rotifer abundance showed a consistent decrease with depth at each station, while copepod and cladoceran numbers tended to increase.

Rotifers represented 90.3% of the individuals sampled, copepod nauplii 7.8%, and adult copepods and cladocerans only 1.9%. Rotifer populations exhibited three distinct peaks during the year, one in winter, another (the largest) in late spring, and the third (the smallest) in late fall. Each population peak was dominated by different species. In winter the dominant species were *Polyarthra vulgaris*, *Keratella cochlearis*, *Conochiloides dossuarius*, and *Anuraeopsis fissa*. In late spring, seven species—*K. serrulata*, *Brachionus angularis*, *B. calyciflorus* and *Hexarthramira* in addition to the first three above—dominated, making up 96% of the total. The late fall peak was dominated by *P. vulgaris*, *A. fissa*, *Syncheata stylatam*, *Trichocera similis*, *B. havanaensis*, and *Microcodon clavus*. Copepod populations showed typical spring and fall peaks. Cladoceran populations peaked in the spring only, an event totally dominated by *Bosmina longirostris*.

Benthic invertebrates in Lake Thonotosassa were numerically dominated by oligochaetes (primarily tubificid worms—commonly called sewer worms because they flourish in the highly eutrophic sediments of sewers) (69.7%) and chironomids (24.7%). Shallow (i.e., better oxygenated) stations generally yielded more invertebrate taxa than did deeper stations. Creek stations exhibited the most taxa as well as the highest density of individuals (36,340/m^2). The deepest station exhibited the lowest recorded density (1,581/m^2). Density of individuals at creek stations appeared to be positively correlated with the presence of organic effluent from sewage treatment plants. The only station not directly influenced by effluent showed significantly lower densities, especially of tubificid worms, than other stations (Dye 1972; Cowell et al. 1974).

The prevailing trends in zooplankton and benthic invertebrate communities lead Cowell et al. (1974) to characterize the lake as eutrophic. Dominance of zooplankton by small-bodied rotifers, the occurrence of blue-green algae, high rates of productivity, and significant oxygen deficits in the summer hypolimnion all point to this conclusion. Dominance of the benthos by oligochaetes and two species of chironomids, *Glyptotendipes paripes* and *Chironomus crassicandatus*, also support this conclusion. These taxa have been linked to eutrophic conditions in other Florida lakes receiving organic wastes and nutrient runoff (Provost 1958; Provost and Branch 1959; Beck and Beck 1969).

In the Alafia and Little Manatee Rivers, freshwater benthic faunas begin to dominate around 28 to 32 km upstream of Tampa Bay (Dames and Moore 1975). Densities are typically low near the oligohaline zone of transition from estuarine to freshwater conditions. Judging from the station-to-station variation in the group or taxa dominating at different times of the year, there must be many localized controlling factors. Common groups include the chironomids, beetles, oligochaetes, pelecypods, mayflies, and isopods. In comparing the two rivers, the Little Manatee tends to have higher species diversities than the Alafia, but lower densities of individuals. The authors (Dames and Moore 1975) relate this general condition to the relative enrichment of the Alafia system with municipal, industrial, and agricultural waste products.

6.2.2 Estuarine Invertebrates

a. Planktonic invertebrates. Macrozooplankton have been studied by Kelly and Dragovich (1967) in Tampa, Old Tampa, Hillsborough, Boca Ciega, and Terra Ceia Bays. Weiss and Hopkins (1973) and Donaldson and Johanson (1977) report on zooplankton of the Anclote estuary. Saloman (1974) presents data on zooplankton off Sand Key in Pinellas County in association with other studies regarding beach restoration. Morris (1976) reports on macroinvertebrate plankton in upper Tampa Bay. Hopkins (1973) presents a general review of zooplankton in the eastern Gulf of Mexico, and Turner and Hopkins (1985) and Weiss and Phillips (1985) review zooplankton and meroplankton studies, respectively, in Tampa Bay in particular. The most authoritative study of Tampa Bay zooplankton, however, is reported by Hopkins (1977).

Quarterly samples at 42 stations within the bay yielded 37 taxa of true planktonic (haloplankton) organisms (Hopkins 1977). These were divided into three categories based on numerical abundance; group 1 ($>1{,}000/m^3$), group 2 ($100–1{,}000/m^3$), and group 3 ($<100/m^3$).

Group 1 consisted of four species, the cyclopoid copepod *Oithona colcarva* (=*O. breviconus*), the calanoid copepods *Acartia tonsa* and *Paracalanus crassirostris*, and a tunicate, *Oikopleura dioica*. These four species account for 60% and 38% of the zooplankton biomass and numbers, respectively. Although *Oithona colcarva* generally outnumbers *A. tonsa* in the summer, the latter ranks first in biomass because of its greater size. In winter *A. tonsa* is more abundant than *O. colcarva*. Since copepod nauplii, which account for 29% of total zooplankton, are not identified to species, the real population numbers of these four species are no doubt higher.

Group 2 consists of six species of copepods, *Evadne tergestina, Oithona nana, Pseudodiaptomus coronatus, O. simplex, Euterpina acutifrons*, and *Labidocera aestiva*. Group 3 consists of 22 species including 11 copepods (*Eucalanus pileatus, Paracalanus quasimodo, Temora turbinata, Centropages hamatus, C. furcatus, Oncaea curta, O. venusta, Corycaeus amazonicus, C. americanus, C. qiesbrechti, Microsetella rosea*); 2 cladocerans (*Penilia avirostris, Podon polyphemoides*), 1 decapod (*Lucifer faxoni*), 2 chaetognaths (*Sagitta tenuis, S. hispida*), 4 tunicates (*Oikopleura longicauda, O. fusiformis, Appendicularia sicula, Doliotum gegenbauri*), 1 siphonophore (*Muggiacea kochi*), and 1 trachymedusa (*Liviope tetraphylla*).

Group 3 consists of a large number of relatively uncommon species which will not be listed as a group.

It is interesting to note that Kelly and Dragovich (1967) report *Lucifer faxoni*, porcellanid crab larvae, brachyuran crab larvae, and *Sagitta hispida*, along with copepods, as the most abundant macrozooplankton of Tampa Bay. Some if not all of the discrepancy could originate from the larger mesh sizes of their sampling gear as well as from annual variations in population makeup.

Total zooplankton numbers were clearly higher in the spring, summer, and fall than in winter. The difference between the three warm seasons and winter approaches an order of magnitude (i.e., 12,700/m^3 in winter to 93,100–108,600/m^3 in the other seasons). Temperature apparently has a profound influence on zooplankton production. With regard to salinity, only 4 of the 10 most abundant species showed any statistical correlation; these were *Paracalanus crassirostris*, *Euterpina acutifrons*, *Oithona simplex* and *O. nana*. All were positively correlated, suggesting that some or all may be seasonal invaders from more marine waters.

Upper Bay and Manatee River stations supported the highest standing crops. Of the group 1 species, *Oithona colcarva* was most numerous in the Manatee River, Boca Ciega Bay, and Old Tampa Bay. *Acartia tonsa* reached its peak abundance in the Manatee River and Old Tampa Bay. *Paracalanus crassirostris* was most abundant in Boca Ciega Bay and Old Tampa Bay and least abundant in Hillsborough Bay. *Oikopleura dioica* was fairly uniformly distributed with the largest populations in Old Tampa Bay and the smallest in lower Tampa Bay.

Among group 2 species, two displayed geographic preferences similar to those mentioned above. *Evadne tergestina* and *Pseudodiaptomus coronatus* were most abundant at upper estuary stations and the Manatee River. Consistent with their high salinity preference, *Oithona simplex*, *O. nana*, and *Euterpina acutifrons* were most abundant in the lower estuary.

As might be expected, group 3 species were abundant in very few samples. Only *Paracalanus quasimodo*, *Centropages hamatus*, *Oikopleura longicauda*, and *Liviope tetraphylla* exceeded 1,000 individuals/m^3 in samples from lower Tampa and Boca Ciega bays. Most group 3 species penetrated no farther than the middle of the estuary, although six occurred as far up as Hillsborough and Old Tampa bays. These were *C. hamatus*, *C. furcatus*, *Lucifer faxoni*, *Liviope tetraphylla*, *Sagitta tenuis*, and *S. hispida*.

Meroplankton (organisms planktonic during only a portion of their life) often constitute a sizable fraction of the total zooplankton. In Tampa Bay the larvae of benthic invertebrates contribute 19% and 8% of zooplankton numbers and biomass, respectively. Again the meroplankton are divided into three species groups based on their median numerical abundance.

Group 1 consists of pelecypod, cirriped, polychaete, and gastropod larvae. Highest average numbers of pelecypod larvae are in Old Tampa Bay. For cirriped larvae, greatest concentrations occurred in Old Tampa Bay and the Manatee River; for polychaete larvae, Boca Ciega and Old Tampa bays; for gastropod larvae, lower Tampa Bay and the Manatee River. All group 1 larvae were least abundant in the winter.

Group 2 meroplankters include echinoderm, bryozoan, and decapod larvae. Echinoderm larvae are most abundant in Boca Ciega Bay and lowest in Hillsborough Bay, Old Tampa Bay, and the Manatee River. Bryozoan larvae are least abundant in the spring, while echinoderm and decapod larvae are lowest in the winter.

Group 3 larvae are only occasionally encountered, mostly in summer collections. Taxa include polyclad, phoronid, brachiopod, enteropneust, ascidian, and cephalochordate larvae, as well as medusae of attached hydroids.

In contrast to these results, Kelly and Dragovich (1967), sampling at a different time and with different equipment, report porcellanid crab larvae and brachyuran crab larvae constituting 27.4% and 10.5% of the macro- and meroplankton, respectively.

b. Benthic invertebrates. As mentioned in the section on habitats, the benthos encompasses a mixture of sand and silt bottoms often dominated by rooted or attached plants, or animal dominated habitats such as oyster reefs. In his recent review of benthic invertebrates of the Tampa Bay System, Simon and Mahadevan (1985) cite over 70 information sources on invertebrates of Tampa Bay, most of them in the grey (unpublished) literature. The majority of this work has been conducted with reference to specific effects, usually associated with local activities such as thermal effluents (Virnstein 1972; Thorharg et al. 1977; Mahadevan and Patton 1979), dredging operations (Taylor and Saloman 1968; Sykes and Hall 1970; Godcharles 1971; Simon and Dyer 1972; Simon et al. 1976), sewage and industrial discharges (Taylor et al. 1970), and canal and seawall construction (Hall and Lindall 1974). Other major works have focused on one species or species groups such as the polychaetes (Taylor 1971; Santos 1972), penaeid shrimp (Saloman 1964, 1965, 1968; Eldred et al. 1965; Sykes and Finucane 1966) or mollusks (Dawson 1953; Sims and Stokes 1967; Finucane and Campbell 1968). Although a considerable body of knowledge has accumulated, relatively few studies have been baywide and inclusive of the full range of benthic invertebrates. The numbers of macroinvertebrate species reported from Tampa Bay has increased from 82 species (Dragovich and Kelly 1964b) to over 1,200 species (Simon and Mahadevan 1985). What portion of this increase is attributable to increasing population diversity or to improved sampling techniques is unknown.

Significant studies also exist on estuarine and coastal locations outside Tampa Bay proper, such as the Anclote River estuary and Sarasota, Roberts, and Dona Bays (Tiffany 1974; Lincer et al. 1975).

In broad terms, the eastern side of the bay is better known than the western side and the shallow areas are better known than deep areas. However, many areas of the bay system have yet to be sampled because of a lack of financial support, manpower, and proximity to perturbations (which usually generate the most impetus for sampling).

Simon and Mahadevan (1985) divide their discussion of invertebrates into three areas: generalities in benthic community composition and abundance, variations in communities, and response and recovery of communities to various stress factors. Among the generalities, three environmental gradients are recognized as influencing distributions of benthic organisms. These are the salinity, sediment composition, and pollution gradients, which are most intense in the upper estuary and relatively moderate toward the lower estuary. It is believed that increases in benthic species richness from upper bay to lower bay are due in large part to the moderation of salinity changes and pollution in the lower bay. The third gradient, sediment composition, is discussed below.

In the upper bay, sediments are finer, relatively less consolidated, and of a higher organic content than in the lower bay, where sorting and flushing lead to coarser, sandier sediment conditions and lower organic content. Correlating with these conditions, deposit feeders (those organisms that feed within or upon the sediment/surface) are more abundant in the upper bay than in the lower bay, while the reverse is true for filter feeders (those organisms which filter feed from the water column). Also, more individuals, though fewer species, tend to be found in the upper than the lower bay. However, it has been shown that the correlation is better for mobile species, both deposit feeders and suspension feeders, in finer sediments and sedentary in sandier sediments. Mobile species suspend sediments while sedentary species consolidate them.

Development and pollution have reduced habitat diversity by the loss of seagrass beds and mangrove forests. This in itself results in a loss of species richness.

Consistent with these trends, the upper bay benthos appears to be dominated by what Simon and Mahadevan (1985) call r-selected species, or opportunists. These species are generally short lived and thus capable of exploiting habitats quickly after periodic stresses. Such species also tend to be more common in the upper than the lower bay. The k-selected species, those that have more complex life cycles, are longer lived, and hence more sensitive to stress. These species are more frequently found in the lower bay.

Seagrass beds have been shown to support greater species richness and abundance of benthic invertebrates than open, unvegetated bottoms (Tabb and Manning 1961; Dragovich and Kelley 1964b; Santos and Simon 1974; Brook 1975; Stoner 1980;

Livingston 1982; Zieman 1982). This community has suffered widespread elimination throughout the Tampa Bay system, affecting not only those species dependent on seagrass as habitat, but also fishes and birds feeding on the species living within the seagrasses.

The preceding are, of course, only generalities. Spatial and temporal variations in such general trends are considerable. For instance, long-term monitoring results strongly indicate the existence of significant seasonal oscillations in numbers of species and abundance per species throughout the bay. The most consistent variation is the presence of more individuals and more species during the winter months than during summer. Although this seasonality appears to be a bay-wide phenomenon, Simon and Mahadevan (1985) believe that the reasons for it differ for different parts of the bay. In Hillsborough Bay, the reason is most definitely summer oxygen depletion (stress). In lower Hillsborough Bay, thermal stress is suspected as an important factor. In Old Tampa Bay, a combination of factors including pollution and thermal stress, absence of tidal flushing, and predation are all possible factors. Delineation of the degree of influence these factors have and their synergistic effects are unknown at this time. It is particularly interesting to note that the seasonal benthic-invertebrate abundance cycle is opposite to that of the zooplankton abundance cycle mentioned earlier.

The effects of five types of stress factors on macroinvertebrates have been investigated in Tampa Bay: red tide, shell dredging, anoxia (oxygen stress), phosphate slime spills, and power-plant entrainment and thermal pollution. In all cases, even where defaunation is total and sediment profiles massively disrupted, recovery usually occurs in 6 to 18 months. Simon and Mahadevan (1985) believe that such resilience exists because of natural stress factors such as red tides, which favor organisms that recover quickly. Such relatively frequent short-term periodic stresses as droughts and red tide may, in effect, preadapt the benthic community to other stresses that originate from human activities (e.g., slime spills, shell dredging, thermal and industrial effluent).

In this regard it must be remembered that virtually all information on invertebrate communities and their response to stress has been collected in recent years, subsequent to major development in the surrounding watersheds. With this in mind, it is interesting to note population trends in one of the major benthic invertebrate communities of Tampa Bay, the oyster reefs. Because they are truly biogenic and thus require constant production in order to sustain themselves, their growth or demise is fairly easy to follow.

The success of the oyster reef depends on a number of factors, including an adequate food supply, suitable substrate, and an oscillating temperature and salinity regime. An adequate food supply is obviously necessary. Hard substrate is required for young oyster spat to settle and attach. Higher summer temperatures promote growth and spawning, but must not be so high as to cause thermal stress. Lower winter temperatures help to force some predators out of shallow waters into deeper, more moderate waters. Oscillating salinities have long been noted to play an important role in oyster-reef ecology. Control of many of the oysters' most devastating predators and parasites has been linked to reduced salinities that force them offshore or inhibit their spread. Examples of predators excluded by low salinity include the oyster drills (*Thais haemostoma* and *Urosalpinx perrugata)*, crown conch (*Melongena corona)*, *Murex* spp., whelks (*Busycon perversum)*, boring sponge (*Chione* sp.), sea urchins (*Echinaster sentus*), and stone crabs (*Menippe mercenaria)*. Devastating parasites such as the fungus *Labrynthomyxa marina* and the turbellarian *Stylochus inimicus* are often also reduced by lowered salinities.

The historical demise of oyster reefs in Tampa Bay is well documented (Dawson 1953; Finucane and Campbell 1968; McNulty et al. 1972). Records date back as far as 1899, long before intensive upland development or dredging began in earnest. Evidence suggests that the chronic effects of development in and around the bay affect the unique ecology of the oyster in a complex and ultimately detrimental manner.

These chronic effects fall into three categories: turbidity from dredging, runoff, and effluent discharges; hydrologic flow-through modifications resulting from dredging, canal and seawall construction, and upland development; and chemical discharges of bacteria, nutrients, and potential toxins from industry, municipal, and nonpoint-source runoff.

Turbidity from runoff or dredging is obviously capable of smothering young oyster spat. A more subtle effect is a relative increase in fine unconsolidated sediments, especially in upper bay waters, making it less likely that oyster spat settle at all. Destabilization, or shoaling, of bottom sediments near channels, dredged canals, and seawalls may also reduce chances of oyster settling and survival.

Hydrologic flow-through modifications occur when the volume of water that a section of the bay normally handles is increased, decreased, or otherwise altered. Increases may arise from construction or deepening and widening of channels that bring more saline waters upstream, as well as hastening the loss of freshwater downstream. Urban development also tends to accelerate the rate and volume loss of freshwater via direct runoff. Without the urban development more of the runoff would be shunted into groundwater recharge or surface storage where it would be released slowly. Canals and seawalls also increase the rate of exchange in some locations by removing the storage capacity of native shoreline areas (e.g., mangroves and salt marshes). In other locations, canals may retard hydrologic flow by creating slow-flushing dead-end systems that do not circulate. In all cases, hydrologic modifications effect changes in background temperature and salinity regimes. As with turbidity, these changes are relatively more intense in the upper bay and shoreline areas than the deeper, lower end of the bay.

Enrichment with chemicals that stimulate algal productivity or are potentially toxic to adults and spat may also affect oyster production. Chlorophyll *a* levels in Tampa Bay have been quite high in the recent past. This nutrient-stimulated soup may contain filamentous algae that clog the oysters' filtering apparatus. The organic load that contributes to depressed oxygen levels is another source of stress to the reef community. Sublethal concentrations of heavy metals, hydrocarbons, and other chemicals are still other stress factors, which are also of special concern to public health in the harvesting of oysters.

It is unlikely that any one of these factors by itself can be clearly shown to be responsible for the decline in oyster production. It seems more probable that chronic changes in the background setting of the bay have tipped the ecological balance against recruitment of spat and establishment and growth of oyster beds, in favor of predators and population-limiting physical factors that reduce oyster reef viability in Tampa Bay.

6.3 Fishes

6.3.1 Freshwater Fishes

The freshwater fishes of the watershed fall into three categories based on the physiological adaptations of their respective families to the marine environment. The principally freshwater species belong to families that have arisen exclusively in freshwater. Consequently, they tend to have little tolerance for brackish water conditions. As might be expected, the number of such species declines from north to south along the Florida peninsula (Briggs 1958), probably because of a lack of suitable habitat as well as the relatively recent emergence of peninsular Florida. Representatives include members of the catfish family (Ictaluridae), the bass and sunfishes (Centrarchidae), and the minnows (Cyprinidae). The principally marine species belong to families with strong evolutionary ties to the marine environment. Many of the species belonging to this group are more commonly recognized as estuarine inhabitants. Nonetheless, some species such as the tarpon (*Megalops atlanticus*), American eel (*Anguilla rostrata*), striped mullet (*Mugil cephalus*), and snook (*Centropomus* spp.) are capable of moving far inland in canals and rivers. Others, such as the croaker (*Micropogonias undulatus*), pinfish (*Lagodon rhomboides*), red drum (*Sciaenops ocellatus*), and ladyfish (*Elops saurus*), are only occasionally (perhaps seasonally) found in oligohaline waters.

The third group, whose members belong to the secondary freshwater families, are believed to have reached the region by a combination of marine and freshwater routes. As such, members of this group tend to be more physiologically tolerant of a wide range of osmotic conditions (euryhaline). Many of the more common and abundant fishes of the area belong to this group, including the mosquitofish (*Gambusia affinis*), the sailfin molly (*Poecilia latipinna*), and the sheepshead minnow (*Cyprinodon variegatus*).

Were it not for human influence, these three categories would serve as a fairly complete list of biogeographic mechanisms influencing fish species composition in an area. Strictly freshwater connections are envisioned for members of the principally freshwater families. These connections probably existed as former sea level (and freshwater tables), higher than at present, incrementally receded, and freshwater species inched their way farther south. For members of secondary families with some tolerance for saline conditions, the connection is perhaps broader because of their ability to invade the brackish fringes of the receding seas. For members of this group, as well as for the principally marine species, at least two factors peculiar to Florida have been identified as facilitating invasion by marine avenues.

In south Florida, where land slopes are low and rainfall seasonal, the estuarine transition zone is both broad and seasonally transient. This creates a zone where the gradient of salinity (or chlorinity) is spread out over a relatively wide area. In addition, the background chlorinity of inland waters is frequently in the oligohaline (or near oligohaline) range, owing to contact with residual salt from past invasions by shallow seas. These two factors (i.e., distance to seawater over an extended gradient and high residual chlorinities) are believed to facilitate the invasion of freshwaters by euryhaline marine species (Odum 1953). A second factor that may aid such invasions is the high concentration of calcium (Ca^{++}) in Florida freshwaters (Hulet et al. 1967). High levels of Ca^{++} have been found to inhibit salt loss and water gain in marine fishes, helping them osmoregulate in less saline environments.

With the advent of man, the release of new species either by accident (aquarium rejects, fish farm escapees) or design (as weed controls, i.e., white amur, *Ctenopharyngodon idella*) has become a new and potentially powerful influence on fish species composition. Aquarium fish such as the oscar (*Astronotus ocellatus*), blue acara (*Aequidens pulcher*), and goldfish have been reported throughout south Florida. The incidence of releases in the Tampa Bay watershed is heightened by the large number of fish farms, particularly in the Alafia and Manatee River basins (see Figure 97). Fish-farm escapees include many aquarium species as well as the tilapia, cultivated for its food value. A long and healthy debate over the potential effects of releasing the white amur into *Hydrilla*-infested lakes has been going on for years. The final resolution has been the tightly controlled and monitored release of sterile hybrids. This compromise solution arises from the fact that the white amur has reproductively established itself elsewhere in the United States. It is feared that if it should do so in Florida lakes, its voracious feeding habits would soon result in the consumption of native vegetation, to the eventual detriment of other fish and wildlife species.

Significant studies of freshwater fishes in the Tampa Bay area include Barnett (1972) and Cowell et al. (1974) in the Hillsborough River, and Dames and Moore (1975) in the Alafia and Little Manatee Rivers. Layne et al. (1977) especially provide one of the more comprehensive compilations of freshwater fish species to be expected in the entire watershed.

Using museum collections, Layne et al. (1977) list 66 species of fishes that may be found in the variety of aquatic habitats of the Tampa Bay watershed (Appendix Table A-12). Another four species of exotic aquarium types believed to be established, but whose habitat is unknown, are included. In waters near fish farms still more species may be periodically reported due to escapes.

Flowing-water habitats appear to support the richest freshwater fish fauna in the study area. Fifty-seven species are reported from the major river systems, while forty-three species are reported from streams and creeks. Although streams and creeks support a large number of species, many unique to this particular habitat type, many (1/4 of the species reported) are under the category of "Population Status Questionable" in Appendix Table A-12. Area lakes also support a high diversity of fishes, with 42 species reported. Ponds (33), ditches (35), marshes (31), and artificial impoundments (27) support moderate numbers of species. Swamps (15) and springs (8) support the lowest. The population status of many of the fish species reported from the latter two habitat types is also considered questionable.

Upon closer examination, these major habitat types may be subdivided even further based on seasonal factors affecting water levels, such as deep marsh and shallow marsh, seasonal or permanent pond and fast- or slow-moving streams and creeks. Local site conditions such as water quality, vegetation, and topography may also influence suitability for certain species. Examples include whether a stream flows into mangroves or cypress, whether a pond is associated with a marsh or a cypress dome, whether cattails or overhanging trees are present in an oxbow, whether canals or rivers are deep with steep banks or shallow with sloping banks, and so on.

Cowell et al. (1974) identifies these five characteristic fish communities in the lower Hillsborough River detention area:

1. The swamp forest community (little instream current), characterized by 16 species. Common members include the Florida gar (*Lepisosteus platyrhincus)*, bowfin (*Amia calva)*, pugnose minnow (*Notropis emiliae)*, mosquitofish, least killifish (*Heterandria formosa)*, and sailfin molly.
2. The swift-current community, represented by the golden shiner (*Notemigonus crysoleucas)*, sailfin shiner (*Notropis hypselopterus)*, iron-color shiner (*Notropis chalybaeus)*, brook silverside (*Labidesthes sicculus)*, and rainwater killifish (*Lucania parva)*.
3. Shorelines vegetated by *Egeria-Hydrilla*, and characterized by 19 species, including the yellow bullhead (*Ictalurus natalis)*, brown bullhead (*I. nebulosus)*, pirate perch (*Aphredoderus sayanus)*, golden topminnow (*Fundulus chrysotus)*, and flagfish (*Jordanella floridae)*. Many of the 19 species are characteristic of other habitats as well.
4. Open waters having little current and supporting spatterdock (*Nuphar* sp.) and/or water hyacinth (*Eichhornia crassipes)*, and characterized by 10 species. Representative species include the longnose gar (*Lepisosteus osseus)*, Florida gar, bowfin, largemouth bass (*Micropterus salmoides)*, bluegill (*Lepomis macrochirus)*, blue tilapia (*Tilapea aurea)*, golden shiner, pugnose minnow, and brook silverside.
5. The open channel with no vegetation, characterized by only seven species, including the longnose and Florida gars, bowfin, Seminole killifish or caledonian (*Fundulus seminolis*), largemouth bass, bluegill, and blue tilapia. These fish may be transient.

In addition to gross differences due to habitat preference, fish species composition and standing crop varies as a function of at least two general factors: biotic interactions such as species life histories, competition, food availability, and disease; and stress factors such as slime spills, drought, and organic pollution, which may cause massive mortality among fish and invertebrate populations in affected areas.

Stress, in particular fish kills due to slime spills, has been well studied in the Peace River (Ware and Fish 1969; Chapman 1973). Such events act as massive reset buttons on the fish community by destroying as much as 91% of the standing crop over long stretches of the river. Recovery occurs through downstream migration and recruitment from tributary populations and upstream movements of catadromous or other eurytolerant species. In one study the first evidence of bass spawning was recorded 13 months after the spill (Ware and Fish 1969). Although many species seemed to have reached a steady-state recovery in terms of numbers by this time, total biomass of fish still appeared to be increasing, indicating that young fish had colonized.

Little is known about the factors controlling fish populations and study of these factors is needed. An understanding of the natural history of these species is necessary before appropriate studies can be undertaken. The following discussion gives what we know about the natural history of the freshwater fishes of the Tampa Bay watershed. Where factors affecting the success of these species are known, these are given as well.

a. Acipenseridae. The Atlantic sturgeon (*Acipenser oxyrhynchus)* has recently been reported from Tampa Bay (Huff 1975; Layne et al. 1977). This record represents the southernmost extent of its range, which reaches to the Mississippi River on the gulf coast and from the St. John's River of Florida to Quebec on the Atlantic Coast. The Gulf of Mexico sturgeon (*A. oxyrhynchus desotoi*) ranges as far south as Charlotte Harbor and was numerous in Tampa Bay in the late 1800's until depleted by commercial fishing (Wooley and Crateau 1985). It is under review for possible listing as endangered by the U.S. Fish and Wildlife Service.

The sturgeon is an anadromous fish, inhabiting coastal marine waters throughout much of the year and migrating into freshwater rivers and streams to spawn. In the southern part of its range, spawning begins in February according to Gilbert (1976), who believes that, although populations may be fairly stable in most parts of its range, it is "severely depleted, or absent, from some areas where it once occurred," including Tampa Bay. Primary reasons for its reductions seem to be the elimination of, or obstructions in routes to, their preferred spawning streams. The species is presently listed as threatened by the Florida Committee on Rare and Endangered Plants and Animals, as a species of special concern by the Florida Game and Fresh Water Fish Commission, and as under review (for possible listing) by the U.S. Fish and Wildlife Service. Its dependence upon large rivers and streams for spawning make it particularly vulnerable to human alteration of such areas. Wooley and Crateau (1985) discuss the migrations, habitats, and exploitation of the Gulf of Mexico sturgeon.

The sturgeon is an omnivorous bottom feeder consuming a wide variety of benthic invertebrates, ranging from chironomid larvae, polychaete worms, and sludge worms to large crabs and mollusks (Gilbert 1976).

b. Lepisosteidae. The gars are represented by two species, the longnose gar (*Lepisosteus osseus)* and the far more common Florida gar (*L. platyrhincus).* The Florida gar occurs in nearly all aquatic habitats—lakes, canals, marsh sloughs, ponds, cypress swamps, and rivers. During high water, it may even move into the mangrove swamps (Kushlan and Lodge 1974; Odum et al. 1982). The longnose gar tends to be less common and generally restricted to larger, slower moving bodies of water.

The gar possesses an air bladder that retains a wide connection to the pharynx; an essential part of the respiratory system, it allows the gar to do quite well in oxygen-limited, stagnant waters. The gar's diet consists of a variety of living and dead animal matter, with fish dominating (Eddy 1969). One particularly interesting adaptation of the gar is the toxicity of its eggs to warm-blooded vertebrates, causing great distress if ingested (Eddy 1969).

c. Amiidae. One species, the bowfin (*Amia calva),* represents this family. Like the gar, it is a widespread species occupying a variety of habitats from shallow marshes to canals to pools and runs. Dineen (1974) reports finding adult bowfin burrowed into the moist peat soils during extreme droughts. Apparently the bowfin is capable of entering a state of prolonged estivation to survive dry conditions.

In addition, the bowfin, or freshwater dogfish, as it is sometimes called, retains a connection between the air bladder and the pharynx which, like the gar, enabls it to use the air bladder as a respiratory organ. Consequently, they may occasionally rise to the surface and take a breath of air. This allows them to live in stagnant waters where oxygen may be limiting for other fishes. They feed primarily on small animals such as crustaceans and small fishes.

d. Elopidae. The tarpon (*Megalops atlanticus)* is reported in both marine and freshwater habitats within the study area. Carr and Goin (1955) report the species as occurring along both Florida coasts and the entire Atlantic and Gulf of Mexico coasts of the United States. In Florida it invades freshwaters, utilizing rivers and canals that enter the ocean and gulf. Bays and estuaries, however, are the most commonly reported habitat in the Tampa Bay area.

This species is widely sought after as a game fish because of its size (up to 300 pounds) and its fighting ability. Adult tarpon prey upon smaller, schooling fishes. During its juvenile stages copepods and small fishes make up 90% of its diet. Each year, the city of Tampa holds a well-attended tarpon-fishing tournament.

e. Esocidae. Two species, the redfin pickerel (*Esox americanus americanus*) and the chain pickerel (*E. niger*), represent this family in the Tampa Bay area. The former species appears to prefer smaller, shallower bodies of water. Like all members of the pike family, the chain and redfin pickerel are voracious carnivores, taking almost any fishes small enough to eat. Of the two, the redfin is smaller, reaching a maximum size of about 30 cm. The chain pickerel may reach 60 cm.

f. Cyprinidae. The Cyprinidae, or minnows, are represented by eight species, the golden shiner (*Notemigonus crysoleucas*), the redeye chub (*Notropis harperi*), the iron-color shiner (*Notropis chalybaeus*), the pugnose minnow (*N. emiliae*), the taillight shiner (*N. maculatus*), the coastal shiner (*N. petersoni*), the sailfin shiner (*N. hypselopterus*), and the dusky shiner (*N. cummingsae*). The largest of the eight is the golden shiner, which may reach 22–25 cm. The coastal shiner is a common species of the shore zone of the Hillsborough, Alafia, Little Manatee, Manatee, and Myakka Rivers (Layne et al. 1977), where it is found to deposit eggs on aquatic vegetation.

The minnows play a key role in the transfer of energy and materials within aquatic ecosystems. As omnivores they consume vegetation, detritus, and microscopic animal life. In turn, they are preyed upon by a wide variety of important predators, including other fishes such as largemouth bass and snook (Ware and Fish 1969).

Minnows are not especially well adapted to fluctuating water conditions and tend to be among the species most rapidly eliminated during fish kills (Kushlan 1974). Of the five species identified by Layne et al. (1977) as being "biologically significant" as indicators of unpolluted aquatic habitats, four, the pugnose minnow, sailfin shiner, iron color shiner, and taillight shiner, are from this family.

In addition to the native cyprinids, the exotic grass carp (or white amur) has been released into Pasco Pond near Land-O-Lakes, Florida, to control *Hydrilla* infestations (Ware and Gasaway 1976). Results of grass carp introduction have varied from near elimination of vegetation (Ware and Gasaway 1976; Mitzner 1978; Miley et al. 1979) to only temporary reductions with subsequent resurgence of the plant community (Colle et al. 1978; Osborne and Sassic 1979; Hardin and Atterson 1980). Carp frequently seek out vegetation other than those species deemed undesirable, leading to significant changes in invertebrate populations, fish food, and fish habitat. These changes may in turn promote local changes in fish species composition and abundance (Ware and Gasaway 1976; Hardin and Atterson 1980).

g. Catostomidae. The sucker family (Catostomidae) is represented by one species, the lake chubsucker (*Erimyzon sucetta*). This species is widely distributed in lakes, ponds, artificial impoundments, and rivers of the watershed. The lake chubsucker is omnivorous, feeding on plant and animal matter gleaned largely from bottom sediments.

h. Ictaluridae. The freshwater catfish family (Ictaluridae) is represented by several species, including the white catfish (*Ictalurus catus*), the yellow bullhead (*I. natalis*), the brown bullhead (*I. nebulosus*), the channel catfish (*I. punctatus*), and the tadpole madtom (*Noturus gyrinus*). The sea catfish (*Arius felis*) and gafftopsail catfish (*Bagre marinus*) belong to the family Ariidae, and are considered principally marine.

Members of the catfish family are usually omnivorous and nocturnal, feeding on a variety of animal and vegetable matter that they locate using their whisker-like barbels. Because of this tactile ability they tend to do better than many other fishes in murky or colored water in which visual food location is difficult. Catfish are found to be one of the most tolerant species to phosphate-slime spills (Chapman 1973). The white catfish and channel catfish are most frequently found in open waters and channels (Ware and Fish 1969; Texas Instruments 1978b), while the smaller bullheads and madtoms occur in these habitats as well as in shallow ponds, sloughs, and mangrove swamps (Kushlan and Lodge 1974).

Three members of the catfish family are considered commercially important in the watershed (Layne et al. 1977); the channel catfish, the white catfish, and the brown bullhead. The channel catfish and the brown bullhead have been successfully stocked into reclaimed phosphate pits (Holcomb 1965; Buntz 1967; Buntz and Chapman 1971).

i. Percichthyidae. Contrary to its name, the striped bass (*Morone saxatilis*) is not a member of the true bass family (Centrarchidae). Although not native to the Tampa Bay watershed, pure stripers and hybrids (striped bass X white bass (*Morone chrysops*)) have been introduced into inland lakes of Polk and Hillsborough counties as a game species by the Florida Game and Fresh Water Fish Commission (Langford 1974). The natural habitats of this anadromous fish are the nearshore to estuarine environs, where the fish spends its adult life, returning to freshwater rivers to spawn (Carr and Goin 1955). Now common in most lakes into which it has been introduced, initial stocking met with mixed success and in some cases poor rates of growth, possibly due to the internal parasite *Goezia* (Langford 1974). Drastic reductions of shad populations have been reported after introduction of the striped bass (Stevens 1975) and may indicate a useful means of controlling numbers of this less desirable species in certain lakes. Because of its pelagic feeding habits, it is assumed not to compete significantly with the more littoral largemouth bass (Langford 1974). Stocking must continue to support populations of this bass, which is not expected to reproduce in lakes of the watershed (Layne et al. 1977).

j. Centrarchidae. The sunfish family (Centrarchidae) is the most numerous family of native freshwater fishes in the Tampa Bay watershed, with 11 representatives. These are the Everglades pygmy sunfish (*Elassoma evergladei*), the Okeefenokee sunfish (*E. okeefenokee*), the bluespotted sunfish (*Enneacanthus gloriosus*), the warmouth (*Lepomis gulosus*), the redbreast sunfish (*L. auritus*), the spotted sunfish (*L. punctatus*), the redear sunfish (*L. microlophus*), the bluegill (*L. macrochirus*), the dollar sunfish (*L. marginatus*), the largemouth bass (*Micropterus salmoides*), and the black crappie (*Pomoxis nigromaculatus*). Many of the centrarchids are popular sport fishes of considerable commercial interest.

The sunfishes are predators of other small fishes, crustaceans, insects, and benthic organisms. They thrive in heavily vegetated ponds, canal margins, and sloughs where prey tend to concentrate, as well as in open waters (Texas Instruments 1978b). Shallow waters are used for nesting by sunfish and bass. Nesting probably peaks in late spring (TI 1978b). For the rest of their life cycle they are dependent upon fairly deep water of good quality. The sunfishes adapt to fluctuating water levels by retreating into deeper waters. Consequently, as the dry season peaks, extremely high concentrations of bass and sunfish may be found in shrinking canals and water holes. Of the 11 species, the Everglades pygmy sunfish ranks as the most divergent form, reaching only about 4 cm in length and living an exclusively benthic existence. Although the sunfish and bass are generally regarded as top carnivores, a truly accurate trophic categorization must take into account food habits at all stages of their life histories (Chew 1974). Young bass (year class 1), for instance, feed heavily on insects, amphipods, and zooplankton. No fish are consumed by these often-numerous young bass. For year class 2, fish become a progressively more important component of the diet. Only by the time they reach year class 3 do bass consume other fish nearly exclusively. Similar life-history transitions are reported for the redear sunfish or "shellcrackers," which they are called locally (Wilbur 1969). Tendipedids (midge larvae) are generally of greater importance to larger individuals, whereas copepods, corixoids (water boatmen), and *Hyalella* (amphipods) are consumed in large quantities by the smaller size groups. Ceratopogonids (biting midges) and gastropods (*Goniobasis*) are eaten mostly by the middle size groups. Seasonal variations in diet appear to be the result of variations in available food items rather than clear-cut preferences. In areas where cichlids have been introduced, centrarchids may be outcompeted.

k. Percidae. The swamp darter (*Etheostoma fusiforme*) is the only representative of this family in the Tampa Bay watershed. It is a small, bottom-dwelling fish reported from lakes, ponds, impoundments, flowing waters, and marshes. Like all Percidae it is predaceous, feeding on small insects and crustaceans (Eddy 1969).

l. Aphredoderidae. This family is also represented by only one member, the pirate perch (*Aphredoderus sayanus*). Ware and Fish (1969) report it as rare in pools, runs and glides and common in riffles in the Peace River. Pirate perch reach a maximum size of about 53 cm. They are predaceous, feeding mostly on aquatic insects and other small aquatic animals (Eddy 1969).

m. Cyprinodontidae. Despite the fact that the cyprinodonts, or killifishes, are not an obligatory freshwater family, but secondary invaders, they are represented by nine native species plus a few aquarium escapees. Those members of the killifish family found inhabiting freshwater habitat within the watershed include the sheepshead minnow (*Cyprinodon variegatus*), the golden topminnow (*Fundulus chrysotus)*, the banded topminnow (*F. cingulatus)*, marsh killifish (*F. confluentus)*, the Seminole killifish (*F. seminolis)*, the starhead topminnow (*F. notti* (*=lineolatus)*, the flagfish (*Jordanella floridae)*, the goldspotted killifish (*Floridichthys carpio)*, the pygmy killifish (*Leptolucania ommata)*, the bluefin killifish (*Lucania goodei)*, the rainwater killifish (*L. parva)*, and the diamond killifish (*Adinia xenica)*. Three other species within the family, the gulf killifish (*Fundulus grandis)*, the striped killifish (*F. majalis)*, and the longnose killifish (*F. similis)*, are generally restricted to more saline conditions of the bay and estuaries, but may be found well up the major tributaries as far as saline conditions extend. The sheepshead minnow, marsh killifish, and diamond killifish may also fall into this group.

In addition to the generally euryhaline background of the killifish family, they also adapt well to fluctuating water levels. Because of their generally small size, they exploit extremely shallow waters and may even invade underground channels in bedrock limestone during dry conditions. The upturned mouths of many of the killifishes allow them to extract oxygen from the thin surface layers of shallow ponds when deeper waters are otherwise devoid of oxygen (Carr 1973; Kushlan 1974).

Perhaps because of their success in exploiting many aquatic habitats of the study area, the killifishes represent a fundamental ecological link between primary and trophically higher fish and wildlife species. Their diet consists of a mixture of plant and animal tissue ranging from periphyton to insect larvae. In turn, they are heavily preyed upon by sport fishes such as the sunfish and bass and wading birds such as woodstork and white ibis. Since killifishes are rapid invaders of newly flooded marshes, prairies, and marginal wetlands, they facilitate the ability of these environments to feed and support fish and wildlife.

n. Poeciliidae. The topminnows or live bearers (Poeciliidae) are represented by three native species, the ubiquitous mosquitofish (*Gambusia affinis)*, the least killifish (*Heterandria formosa)*, and the sailfin molly (*Poecilia latipinna)*; and four aquarium escapees, the swordtail molly (*P. petenensis)*, liberty molly (*P. sphenops)*, black molly (*P. latipinna* x *velifera)*, and the guppy (*Poecilia reticulata)*. Two of these species, the mosquitofish and sailfin molly, are euryhaline, occupying a range of habitats from lake margins to salt marshes. The least killifish is abundant in shallow marshes, prairies, and freshwater pockets within mangrove swamps, but is seldom found in brackish waters. According to Kushlan and Lodge (1974), it prefers thick emergent or submerged vegetation.

Along with the killifishes, members of the Poeciliidae family play a key role in the diet of birds and sport fishes of central and southern Florida. They feed primarily on small insects, crustaceans, and attached periphyton. The size range and upturned mouths are very similar among members of both families. Poecilids generally avoid the problem of losing eggs to desiccation by internal fertilization and development. The female carries the developing eggs until they hatch and the young fish emerge alive.

o. Clariidae. One species, the walking catfish (*Clarias batrachus)*, makes up this secondary family of fish. Originally imported from South America as a curiosity for aquarium owners, the potential impact of the spread of walking catfish in Florida is considerable. These fish are capable of moving overland from drying ponds to other bodies of water. They can also burrow into bottom sediments during periods of drought or cold weather and remain dormant for months (Courtenay 1970). As they congregate in drying ponds, they may devour all animal life within a few weeks, leaving little food for native fish and wildlife species. However, the catfish itself may serve as a food source for larger species (Duever et al. 1979).

p. Cichlidae. Eight of the species of exotic fish currently established in south-central Florida are members of the tropical secondary freshwater family Cichlidae. A highly diversified group, the cichlids are considered to be in many ways the tropical ecological counterpart of the centrarchids (sunfish family). Members of this family are generally well adapted for survival, due to their ability to withstand drought, their highly developed system of parental care of young, and their general aggressiveness. The ability to withstand drought makes them especially competitive in south Florida. The Centrarchidae comprise a freshwater family that reaches the southern limit of its range in south Florida in habitats characterized by seasonal drought, to which the family is poorly adapted (Kushlan 1974). It is anticipated that the spread of cichlids will be at the expense of the native centrarchids. The range expansion of the jewel fish (*Hemichromis bimaculatus*), already widespread throughout southern Florida, was aided by its tolerance of brackish water and its use of the extensive canal system of the interior. The interactions and fate of the exotic and native fish fauna of southern Florida should be a matter of concern in the area of Florida just south of the Tampa Bay watershed. It is likely that survival of cichlids farther north will be increasingly limited by their intolerance of cold. However, in spite of this, Texas Instruments (1978b) reports the mouth-breeding blue tilapia (*Tilapea aurea*) constituting as much as 30% of the fish biomass of open river waters during an October sampling in the Peace River.

q. Atherinidae. The silversides are a family peripheral to freshwaters. Only one of the two species reported from the Tampa area, the brook silverside (*Labidesthes sicculus*), is found in freshwaters. The tidewater silverside (*Menidia beryllina*), as the name suggests, is more estuarine in its habits. The former fish occurs in open canals, lakes, clear-water ponds, and deep cypress sloughs throughout the study area. According to Layne et al. (1977), the brook silverside is an important biological indicator species of unpolluted conditions. Brook silversides anchor their eggs in gravel bottoms on long filaments (Texas Instruments 1978b).

r. Clupeidae. The herring family is also peripheral to fresh waters; only two of four species found in the area are characterized as principally freshwater dwellers. These are the gizzard shad (*Dorosoma cepedianum*) and the threadfin shad (*D. petenense*). Rather large, these omnivorous fish tend to frequent canals, rivers, channels, and open waters, where they feed on plankton. Though considered a freshwater species, they may use brackish waters as well. The shad prefer slow-moving or sluggish waters. Some authorities regard gizzard shad as an indicator of poor water-quality conditions. Attempts have been made to selectively remove the less desirable shad from area lakes (Lake Tarpon) by rotenone treatments (Phillippy 1964).

s. Belonidae. The Atlantic needlefish (*Strongylura marina*) is a primarily estuarine species that occasionally enters freshwaters. Ware and Fish (1969) report only rarely encountering this species in pool habitats along water courses entering the estuary.

t. Anguillidae. Although the American eel (*Anguilla rostrata*) belongs to a family peripheral to freshwaters, it is a common inhabitant of area rivers (Ware and Fish 1969; Dames and Moore 1975). The eel is a catadromous species, living in freshwaters but spawning in marine waters. When the young migrate into the estuaries, the males remain in brackish waters, while only the females proceed upstream, mostly traveling at night. The eels remain here 5 to 7 years until they are sexually mature. Upon migrating downstream, the mature females join the males and move offshore to spawn (Eddy 1969). Eels are omnivorous, feeding on all kinds of animal food, both dead and alive.

6.3.2 Estuarine and Marine Fishes

During the last 25 years, numerous studies have been conducted regarding the community structure, distribution, and migration of the fishes in and around Tampa Bay. Investigations centered along coastal areas and in lower Tampa Bay include those of Moe and Martin (1965) offshore of Pinellas County; Fable and Saloman (1974) along the coastal beaches in Pinellas County; Saloman and Naughton (1979) between Long Key and Clearwater pass; and McNulty et al.

(1974) at Maximo Point in lower Tampa Bay. Additional reports on the fishes in lower Tampa Bay include those by Moe (1964) on a fish kill at the Sunshine Skyway Bridge in 1963, resulting from a red tide bloom; Woodburn (1959, 1962) on the marine fauna near the P.L. Bartow Power Plant in Pinellas County and near John's Pass in Boca Ciega Bay; and Rinckey and Saloman (1964) on a fish kill resulting from unseasonably low water temperatures in this area.

The most comprehensive report on the fishes of lower Tampa Bay is included in the study by Springer and Woodburn (1960), who discuss in detail the population structure, patterns of migration, distribution, and relative abundance of approximately 80 species represented in their collections from this area. Comp (1985), in a recent review of fishery investigations conducted in the Tampa Bay area, also provides an excellent summary of the distribution and migration of fishes in and out of the bay, relationships between estuarine habitats and fishery resources, and the detrimental consequences of habitat destruction.

A complete listing of fish species from Tampa Bay reported by Comp (1985) is provided in Appendix Table A-13. This list of 203 species includes predominantly marine and estuarine fish. In this context "marine" refers to those species usually collected from lower Tampa Bay or along or just offshore of coastal beaches. Those species referred to as "estuarine" are usually collected from central Tampa Bay, Hillsborough, and Old Tampa bays or at river mouths. Species designated in the list as both marine and estuarine utilize both types of habitats, or are migratory and can be expected to occur in either area during some part of their life cycle.

A few predominantly freshwater species incidentally collected near freshwater sources in Tampa Bay are also included in Appendix Table A-13. All of these species, according to Comp (1985), would be considered "uncommon" components of the Tampa Bay fish community. Many of the marine species listed are also uncommon or rare in fishery collections or observation in Tampa Bay, being species either naturally rare or incidental to the area. Many of these fish are more commonly associated with marine conditions and habitats further offshore.

It has been estimated that around 90% of all the important sport and commercial fishes of the Gulf of Mexico use estuaries at some time in their life cycle. For many species, estuaries are most vital as a protected nursery area for larvae and juveniles. The nursery function arises from the high productivity of estuaries, which provides an abundant source of food to larvae and juveniles, as well as through restricting the numbers of predator species to those capable of withstanding the euryhaline conditions. Figure 121 shows the seasonal distribution in Tampa Bay of the juveniles of some fish species.

The timing of spawning in the Gulf of Mexico and subsequent seasonal movement of the young into Tampa Bay coincides with summer, the period of highest estuarine production. A second peak in numbers of fish larvae occurs in late summer and fall and involves fewer species.

One of the major questions in this general model of estuarine dependence is how weak-swimming larvae make their way into estuaries against the net outflow of water. Many investigators have shown that larvae regulate their vertical distribution in the water column to take advantage of differential flow gradients that are temporarily available in a two-layered system over a tidal cycle (Robison 1985). Given the physical situation, individuals seeking out bottom waters at all times appear to have a greater probability of moving into upper bay waters than those in the upper water column. However, the fact that many common estuarine species exhibit distinct behavioral preferences for

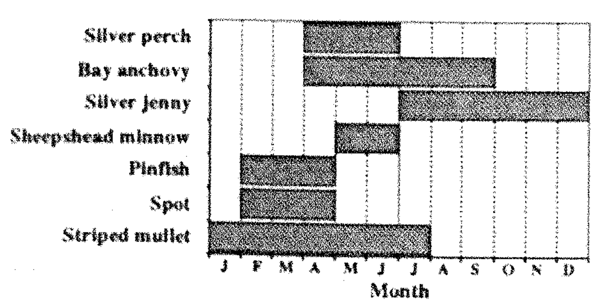


Figure 121. Seasonal distribution of selected juvenile fishes within the nursery areas of Tampa Bay (after Comp 1985).

certain depths (not all on the bottom) strongly suggests that other factors must be involved in the migratory process. Studies of circulation and the interaction of wind and current on smaller spatial scales are necessary to determine these factors.

The seasonal movement of adult fishes in and out of the estuary is similar to those of the juveniles in that peaks in relative abundance generally occur in the spring and early fall (Comp 1985). Decreases in relative abundance are apparent from the onset of low water temperatures in December through February, when many species apparently migrate to the gulf or to the deeper areas of the bay.

Seasonal salinity variation is generally regarded as the main influence around which estuarine fish communities are organized. Temperature, substrate, and the influence of detritus have also been noted as important background factors (Odum et al. 1982). Based on these factors, Odum et al. (1982) identify the following four characteristic fish assemblages in south-west Florida estuaries (Figure 122):

1. The basin mangrove forest community.
2. The tidal stream and river community.
3. The estuarine bay fringing community.
4. The oceanic bay community.

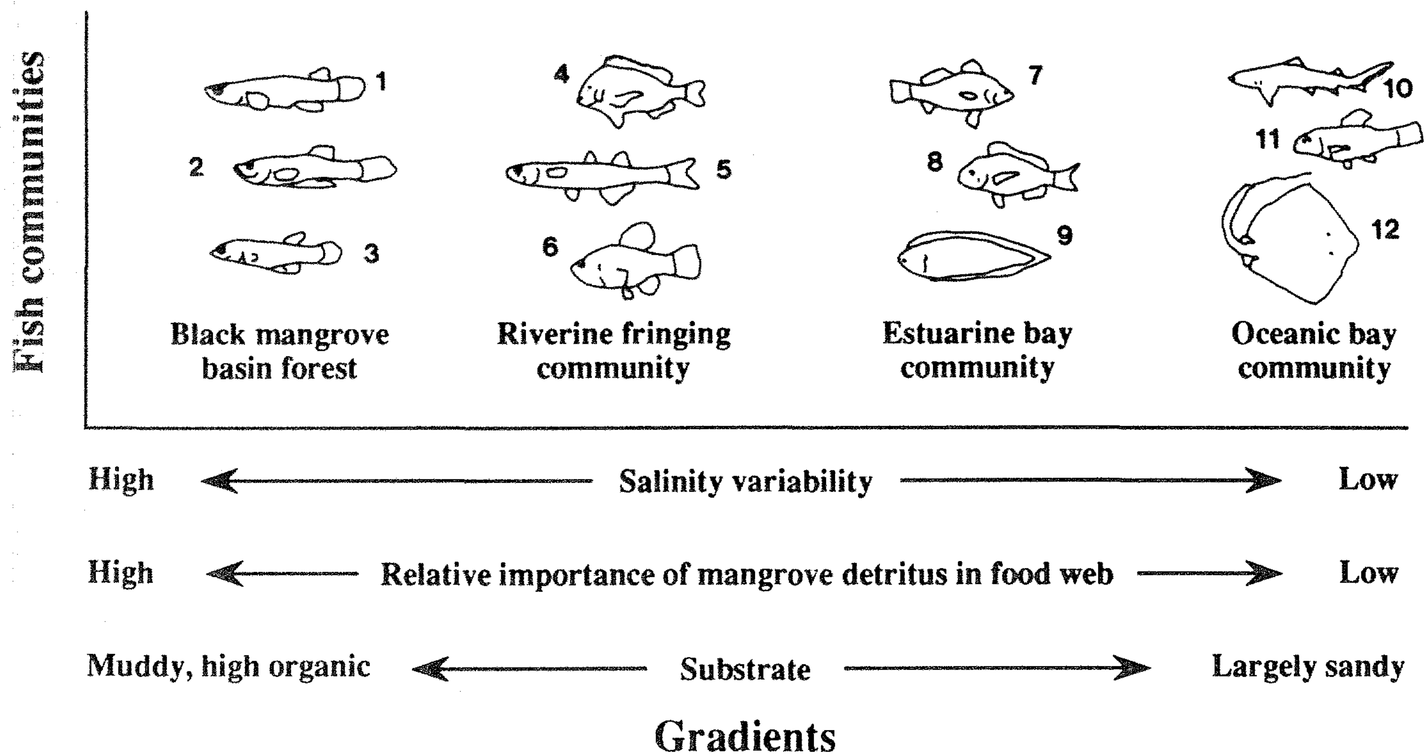
a. Basin mangrove forest community. The basin mangrove forest community occurs within the estuarine wetlands (salt marshes and mangroves) where depressions hold a combination of rainwater, runoff, tidal overflow, and saline ground water. The fishes that occupy these basin mangrove communities consist largely of the euryhaline killifishes (Cyprinodontidae) and livebearers (Poeciliidae) discussed previously for freshwater communities. Water depth is generally very low (0.3–1 m) and the mud substrate is generally high in hydrogen sulfide and low in dissolved oxygen (0–2 mg/L). The selection pressure in such a setting obviously favors euryhaline characteristics and high tolerance to low oxygen concentrations.

Remarkably, the members of this community are permanent residents, completing their life cycles within this harsh setting. Important members of this community are the mosquitofish (*Gambusia affinis*), marsh killifish (*Fundulus confluentus*), sheepshead minnow (*Cyprinodon variegatus*), sailfin molly (*Poecilia latipinna*), flagfish (*Jordanella floridae*), and rainwater killifish (*Lucania parva*).

As a group, these fishes represent an important trophic link for many other fish and wildlife. They are omnivorous, feeding on small invertebrates and larval fishes as well as on mangrove debris and algae. During high water, members of this community may move downstream where they become the prey of larger fishes such as snook, tarpon, ladyfish, Florida gar, and mangrove snapper. During low water the community members tend to concentrate in receding pools and ponds where wading birds such as herons, egrets, white ibis, and woodstork may feed upon them.

b. Tidal stream and river community. Where coastal streams provide a continuous connection between upstream fresh (or fresher) waters and downstream estuaries, a second fish community can be defined. This is the tidal stream and river community; it supports a larger number and wider variety of fish species than the basin mangrove forest community. Seasonal oscillations of environmental conditions and the relative ease of movement between upstream and downstream habitats create a diverse system habitable to a variety of species during one or more stages in their life cycles (Odum et al. 1982).

During the wet season the influx of freshwater brings with it many fishes that are characteristic of upstream marshes and sloughs. These include the Florida gar (*Lepisosteus platyrhincus*), several members of the centrarchid family such as sunfish (*Lepomis* spp.), and largemouth bass (*Micropterus salmoides*), the yellow bullhead (*Ictalurus natalis*), the tadpole madtom (*Noturus gyrinus*), the bluefin killifish (*Lucania goodei*), and the rivulus (*Rivulus marmoratus*) (Dames and Moore 1975, Odum et al. 1982) Fish species which commonly spend a portion of their life cycle in the mangrove-lined tidal streams and rivers of the Tampa Bay watershed include the killifishes (Cyprinodontidae), livebearers (Poeciliidae), silversides (Atherinidae), mojarras (Gerreidae), tarpon (Elopidae), snook (Centropomidae), snappers (Lutjanidae), sea catfishes (Ariidae), gobies (Gobiidae), porgys (Sparidae), mullet (Mugilidae), drums (Sciaenidae), and anchovies (Engraulidae).



1) Rivulus	4) Juvenile sheepshead	7) Silver perch	10) Lemon shark
2) Mosquito fish	5) Tidewater silverside	8) Pig fish	11) Gold-spotted killifish
3) Marsh killifish	6) Sheepshead minnow	9) Blackcheek tongue fish	12) Southern stingray

Figure 122. Estuarine fish communities (after Odum et al. 1982).

During the dry season, higher salinities force freshwater forms farther upstream and allow marine fishes to invade the tidal streams and rivers. Species that characteristically move into these areas at such times include the needlefishes (family Belonidae), stingrays (Dasyatidae), jacks (Carangidae), and barracuda (*Sphyraena barracuda).* During the same general period of the year (December through May), low temperatures may induce some species such as the lined sole (*Achirus lineatus*), the hogchoker (*Trinectes maculatus*), the bighead searobin (*Prionotus tribulus*), and the striped mullet (*Mugil cephalus*) to move offshore where temperatures are more moderate.

In addition to temperature- and salinity-induced fluctuations in fish species composition and abundance, the tidal streams and rivers provide a nursery for the larvae and juveniles of numerous marine and brackish-water species that spawn farther offshore (Dames and Moore 1975; TI 1978b). Larval recruitment generally peaks during late spring and early summer when salinity is reduced over relatively large areas of the estuary. Another important contributing factor to the nursery value of tidal streams and rivers is the abundant detrital food source brought in during late spring when freshwater runoff peaks.

c. Estuarine bay community. This community consists of the open estuarine waters (e.g., lower Tampa Bay, proper). The major environmental difference between the bay habitat and the tidal river habitat is the degree of salinity fluctuation. Bay salinities tend to fluctuate less here than in and near the rivers. Consequently, true freshwater forms are rarely found, while many more marine species are able to inhabit the area permanently or seasonally. In addition to generally higher salinities, the bays also afford access to submerged beds of seagrasses and algae, and oyster reefs. For many fish species, these biotic substrates provide additional protection and nutrition that are not available in the tidal rivers.

Odum et al. (1982) divide this fish community into two somewhat overlapping groups: the benthic or demersal fish fauna and the mid- and upper-water fish fauna. Dominant families associated with the benthos are the drums (Sciaenidae), porgys (Sparidae), grunts (Pomadasyidae), mojarras (Gerreidae), snappers (Lutjanidae), and mullet (Mugilidae). Less dominant but still significant contributors are members of the pipefish (Syngnathidae), flounder (Bothidae), sole (Soleidae), searobin (Triglidae), and toadfish (Batrachoididae) families. Dominant species of the benthic fish fauna are the common pinfish (*Lagodon rhomboides*), the silver perch (*Bairdiella chrysoura*), the pigfish (*Orthopristis chrysoptera*), striped mullet (*Mugil cephalus*), spot (*Leiostomus xanthurus*), and the mojarras (*Eucinostomus gula* and *E. argenteus*). In the middle and upper waters, important families are the anchovies (Engraulidae), herrings (Clupeidae), and needlefishes (Belonidae). Dominant species within these families are the anchovies (*Anchoa mitchilli* and *A. hepsetus*), code goby (*Gobiosoma robustum*), Gulf pipefish (*Syngnathus scovelli*), sheepshead (*Archosargus probatocephalus*), and clupeids (*Brevoortia smithi*, *B. patronus*, and *Harengula pensacolae*) (Springer and Woodburn 1960).

d. Oceanic bay community. This fish community is exemplified by Florida Bay south of the Everglades, a shallow bay of nearly uniform oceanic salinities, having clear waters and a sandy bottom. Because of the proximity to open ocean water with its diverse fauna, this community tends to support the most species of the four. In the area covered herein, the conditions that define this community are best approximated by Boca Ciega, Sarasota, and Lemon Bays. Though a general paucity of systematic fishery data makes it impossible to verify whether these bays do, in fact, meet the criteria, Comp (1985) confirms a distinct increase in number of species toward the lower end of Tampa Bay.

The preceding gradient of fish communities, though useful as a general organizing framework, is nonetheless a simplification of the total picture. Many local, seasonal, and long-term variations occur in estuarine fish populations of the Tampa Bay watershed, and much remains to be investigated. Recently, Comp (1985) presented a comprehensive review of the available fishery data on Tampa Bay. The following is a summary of some of the more salient features of his review that have not already been discussed.

Despite the high number of species (203), relatively few taxa dominate the catch, with 10% to 15%

of the species usually making up 88% to 98% of the individuals (Table 41). The more common dominants include the scaled sardine, pinfish, bay anchovy, tidewater silverside, majorras, mullet, silver perch, and killifishes. The shoreline beach environment is similar, except that gulf and northern kingfish and pompano tend to be more common. Pinfish are particularly common in the lower bay, while tidewater silverside and/or bay anchovy dominate the upper bay.

In terms of habitat distribution, a higher number of species are found along the shallow shelves of the bay. The highest numbers of individuals tend to locate in protected upper-bay waters, in mangrove areas or associated with grass beds.

Seasonal use of the estuary by fish peaks in spring. Numbers of individuals and of species are at their maximum primarily because of larvae and juvenile migrants. During summer, the numbers tend to decline as individuals grow and mortality and outward migration reduce and disperse their populations. In the fall, there appears to be a secondary peak in numbers of individuals as a result of past spawning immigration. Compared to spring, the fall peak is characterized by fewer species, but a greater number of individuals per species. Winter is considered the seasonal ebb in terms of both numbers of species and individuals using the estuary.

6.4 Amphibians and Reptiles

Habitat-specific studies on herpetofauna within the Tampa Bay watershed are few. Telford (1952) discusses the ecological distribution and relative abundance of amphibians and reptiles in the vicinity of Lake Shipp, Polk County, Florida. Stevenson (1967) lists the amphibians and reptiles of the Hillsborough River State Park, noting their relative abundance. More recently, McDiarmid and Godley (1974) report on a survey of the Hillsborough flood detention area, listing 71 species collected or expected to be found in the nine major terrestrial and aquatic habitats delineated in their study area. A brief review on the status of reptiles inhabiting estuarine and marine habitats in Tampa Bay is provided by Reynolds and Patten (1985). The most comprehensive account of the herpetofauna of the region, however, is provided by Layne et al. (1977), who summarize the status, distribution, and biological significance of amphibians and reptiles in a seven-county area, including Hillsborough, Polk, Manatee, and Sarasota Counties in the Tampa Bay watershed.

Table 41. Dominant fish species, in order of abundance, collected in selected areas of Tampa Bay and the percentage of the catch represented by those species (adapted from Comp 1985).

Maximo Point (McNulty et al. 1974)	**Big Bend** (Comp 1977)	**McKay Bay** (Schleuter and Price, unpublished)
Silver jenny	Tidewater silverside	Tidewater silverside
Pinfish	Bay anchovy	Striped mullet
Tidewater silverfish	Longnose killifish	Longnose killifish
Spotfin mojarra	Spotfin mojarra	Bay anchovy
Longnose killifish	Striped mullet	Spot
Silver perch	Sheepshead minnow	Scaled sardine
Pigfish	Silver jenny	Pinfish
Bay anchovy	Rough silverside	
	Scaled sardine	
	Pinfish	
88% of catch	**91% of catch**	**92% of catch**

From these records, a total of 94 species—27 amphibians, including 8 salamanders and 19 frogs; and 67 reptiles, including the alligator, 18 turtles, 1 amphisbaenid, 17 lizards and 31 snakes—may be expected to be found within the Tampa Bay watershed. This diverse and complex assemblage of species comprise over 60% of the total herpetofauna recorded for the State. The estimated distribution and relative abundance of each species by habitat, according to Layne et al. (1977), are shown for terrestrial reptiles in Appendix Table A-14, for wetland and aquatic reptiles in Appendix Table A-15, for terrestrial amphibians (that is—amphibians that can be found in terrestrial habitats) in Appendix Table A-16, and wetland and aquatic amphibians in Appendix Table A-17. A summary of this information highlighting the relative number of amphibian and reptile species in the various habitat categories is graphically presented in Figure 123.

Cypress and hardwood swamps appear to support the greatest diversity of amphibians and reptiles. Together, these two habitats account for 85% of all the amphibians (23 spp.) and over half (36 spp.) of the reptile species reported from the Tampa Bay area. McDiarmid and Godley (1974) also report riverine swamp forest as having the highest index of diversity and abundance of reptiles and amphibians in their survey. Admittedly, few species are found exclusively or in any great abundance in either habitat type. Rather, the transitional swamp forest—between true aquatic and more terrestrial systems—appears to attract many species common to both. These small patches of cypress and hardwoods occupying wet depressions, especially in pine flatwoods and prairies, provide an oasis for numerous species, especially amphibians, during times of breeding and drought. No endangered or threatened species are known to use the cypress or hardwood swamps exclusively or primarily (Woolfenden 1983), but because of their isolation these habitats may be important refuges for some populations in adjacent areas.

Mangrove and artificial swamps, in contrast, support fewer species. Brackish to saline conditions in the former habitat limit many species, while the lack of stability in artificial swamps, usually associated with impoundments or other human-modified structures, may be the reason for low species numbers in the latter.

Among the true forest-type habitats, pine-turkey oak and typical flatwoods support the majority of species, followed in descending order by live oak hammocks, groves/parklands/etc., mesic hammock, sand pine scrub, scrubby flatwoods, cabbage palm hammocks, and bay forests. Reptiles abound here, especially those adapted to burrowing. The sand pine scrub and pine-turkey oak habitats may support dense populations of gopher tortoises. The well-drained soils characteristic of these habitats allow for extensive tunnels, and the vegetation includes many low-growing succulents used as food (Auffenberg 1978). The gopher frog uses the tortoise burrows, so it also is a common inhabitant (Fogarty 1978). The short-tailed snake, another burrower, appears to be more common in the yellow sands of longleaf pine habitat than the sand pine habitat (Campbell 1978). A species endemic to Florida, this snake is thought to have an extremely narrow habitat tolerance, but little is known of its life history and ecology (Woolfenden 1983). Other Florida endemics of this habitat are the Florida scrub lizard, blue-tailed mole skink, and sand skink.

Aquatic habitats support many species, including the majority of turtles, snakes, and frogs listed in Appendix Tables A-14 through A-17. It is here that amphibians approach reptiles in species richness. Characteristic species include the greater siren, southern cricket frog, pig frog, American alligator, and banded water snake. The lesser siren is typical of ponds in pine flatwoods areas and may be abundant in water hyacinth-covered ditches as well (Layne et al. 1977). Springs support relatively fewer species. One spring-dweller of note is the Suwannee cooter. In more xeric terrestrial habitats (i.e., dry brushland, dry prairie, pasture/croplands, dunes/beaches flats, and artificial barrenland), the number of reptile species is drastically reduced and amphibians are essentially absent. Urban areas also appear to fall into this category.

It should be noted that the actual occurrence and abundance of a species in a particular area is highly dependent on the suitability of the habitat (microhabitat) or adjacent habitats to support the animals' natural requirements of food, cover, and reproduction. These

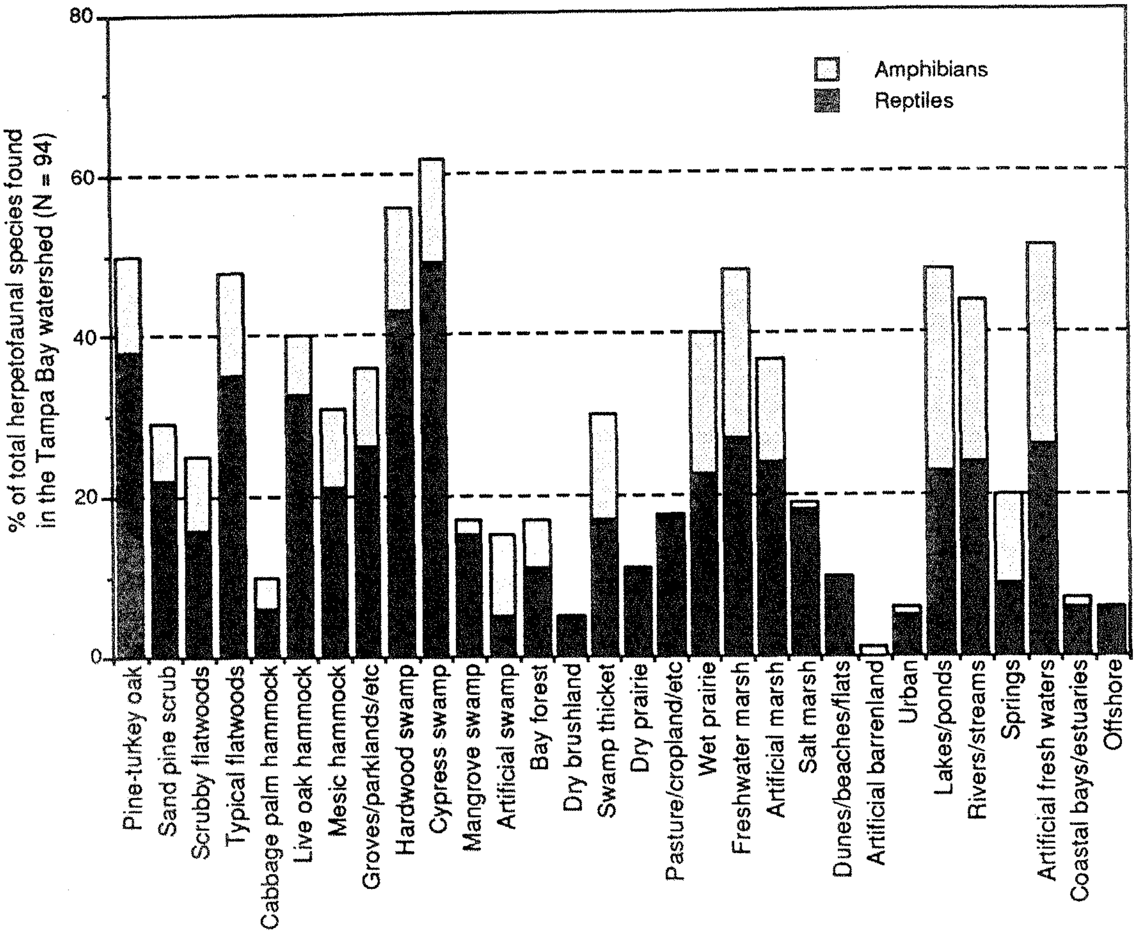


Figure 123. Relative abundance of amphibian and reptile species in various habitat categories within the Tampa Bay watershed.

requirements, as for many amphibians and reptiles, may vary seasonally in response to behavioral and developmental adaptations to perform reproductive and thermoregulatory functions. For example, amphibians, in general, require aquatic habitats to reproduce. Terrestrial species exemplified by toads (*Bufo, Gastrophryne*) and arboreal species of *Hyla* tend to be dependent on the rains of late spring and summer for reproduction and use the more ephemeral ponds where predation and competition pressures may be lower (McDiarmid and Godly 1974). Riparian and semiaquatic frogs (e.g., *Acris* and *Rana* spp.) often use more permanent waters and tend to have prolonged breeding and/or developmental periods.

As for other faunal and floral groups, the geological history of central Florida and the geographical position of the peninsula in relation to the main continental land mass of North America affects the rate of invasion and the distribution of the herpetofauna. General discussions of geographical origins and affinities of the Florida herpetofauna are included in Carr (1940), Neill (1954), Goin (1958), and Telford (1965). The majority of the species have invaded the peninsula from the southeastern Atlantic Coastal Plain. Not all of these species that occur through much of Florida have diverged morphologically from populations elsewhere. Examples of such species in the study area are the spadefoot toad, stinkpot turtle, six-lined racerunner lizard, southeastern five-lined skink, eastern hognose snake, and coachwhip snake. Boyles (1966) concludes that these species have been present on the Gulf Coastal Plain and in Florida without prolonged geographic isolation.

Many other species have invaded Florida from the west along the Gulf Coastal Plain (Neill 1957). Their closest relationships are with species or larger taxonomic groups now found in the southwestern United States, Mexico, and Central America. Examples of this group in the Tampa Bay area include the ground skink, pine woods snake, eastern indigo snake, pine snake, coral snake, and eastern diamondback rattlesnake.

Still other species that have been recorded from the area are forms whose ranges extend throughout tropical regions of the Western Hemisphere. These include the American crocodile, Atlantic green turtle, Atlantic loggerhead, Atlantic ridley, and Atlantic leatherback.

Of the seven exotics in the Tampa Bay watershed, the greenhouse frog, Cuban treefrog, and the brown anole have West Indian affinities. These three species are fairly widely distributed in Florida and inhabit natural as well as human-modified habitats. Duellman and Schwartz (1958) speculate that the invasion of natural habitats by these species indicates either that they have been present in Florida for longer than other introduced species or are more adaptable to the environmental conditions present. Neill (1957) suggests that their success may simply reflect the presence of near-tropical habitats that are unoccupied by amphibians and reptiles of temperate stocks. Of the other exotic species, the giant toad may have been introduced from almost anywhere in the Caribbean or Gulf of Mexico, while the gecko and the Mediterranean gecko are found in tropical regions around the world. The Texas horned lizard is native to the southwestern United States.

All of the endemic Florida herpetofauna, with the exception of the rim rock crowned snake, occur in parts or all of the Tampa Bay watershed. These endemic species are the Florida red-bellied turtle, Florida scrub lizard, sand skink, worm lizard, short-tailed snake, and crowned snake. Two other species, the striped mud turtle and the striped swamp snake, once endemic, are currently extending their ranges northward into southern Georgia (Layne et al. 1977). Other species that, although not endemic, underwent much of their evolution in the Florida peninsula before invading parts of the southeastern Gulf Coastal Plain include the dwarf siren, pig frog, gopher tortoise, Florida softshell turtle, mole skink, island glass lizard, and black swamp snake.

As the land in central Florida was periodically isolated during past fluctuations in sea level, the true Florida endemics and the "semi-endemics" that moved northward during a drop in sea level could have been isolated and differentiated from their parental stocks, or they may represent relict populations of species that were once widespread but now extinct elsewhere. It is significant that most of these species are burrowers in sand or mud, and that all of the true endemics except the Florida red-bellied turtle are characteristic of sandhill and sand pine scrub habitats.

Populations of some species that invaded the Florida peninsula in earlier geologic times have differentiated to form new races, presumably as a result of adaptation to subtropical environments, and probably more importantly, isolation from parent stocks (Neill 1957). Species with peninsular subspecies include the newt, snapping turtle, mud turtle, cooter, scarlet snake, king snake, mole skink, banded water snake, black swamp snake, rat snake, kingsnake, and crowned snake. These different races often possess subtle differences in habitat requirements. Of special significance is the fact that on the Lake Wales Ridge, part of which lies in Polk County, three reptiles have differentiated populations: the worm lizard, blue-tailed mole skink, and the peninsula crowned snake.

Florida has an unusually large marine and brackish water herpetofauna. Reasons for this include its long coast line and numerous islands; low, flat topography, which accounts for subtle stream gradients that might allow inland species to gradually adapt to brackish water conditions; repeated inundations during its history, forcing some species into saltwater habitats and favoring the survival of those that could adapt; oligohaline waters formed as a result of the gradual solution of salt deposits left in interglacial periods, which may serve as zones of evolutionary adaptive exchange between freshwater and saltwater (Odum 1953); and the general diversity of saltwater habitats along the coast. Furthermore, the rich and varied nature of the resident herpetofauna increases the likelihood that some native species will adapt to saltwater habitats (Neill 1958).

According to Layne et al. (1977), almost one-third of the amphibians and reptiles in the study area are known to occur in saline habitats (Appendix Tables A-15 and A-17). This list includes 2 frogs, the American alligator, 11 turtles (including 4 sea turtles and the gulf coast box turtle, 1 lizard, 1 skink, and 10 snakes (including the mangrove water snake and the Everglades rat snake). A recent review of reptiles of the Tampa Bay estuary (Reynolds and Patton 1985) list only seven species considered exclusively estuarine or marine dependent. Five are marine turtles, including the Atlantic hawksbill, Atlantic green turtle, Atlantic loggerhead, Atlantic ridley, and the Atlantic leatherback. The other two species, the mangrove water snake, and the diamondback terrapin are more estuarine in distribution.

Of the five marine turtles that may visit the Tampa Bay area, only two nest there. The hawksbill is at most an infrequent nester, while the loggerhead annually nests on Manasota Key (Reynolds and Patton 1985). Nest numbers have been fairly stable from 1979 to 1981 at 245, 153, and 251, respectively. According to Reynolds and Patton (1985), lower numbers in 1980 probably reflect a sampling bias rather than a significant decline in nesting.

The biologically significant amphibians and reptiles are listed in Table 42. The general trend in the area appears to be a decline in species associated with sandhills and sandpine scrub as increasing acreage is converted or modified for agricultural or other uses. Wetlands, another species-rich habitat, are also declining in number and size due to extensive drainage for development.

6.5 Birds

References on birds of the Tampa Bay area include Schreiber and Schreiber (1978) on shore-bird and wading-bird use of spoil islands, Hirth and Marion (1979) on birds of south Florida flatwoods, Woolfenden and Schreiber (1973) on birds in the lower Hillsborough River area, and Cutright (1981) on bird use in terrestrial habitats. Layne et al. (1977) present a summary of information on the vertebrate fauna of the area which includes birds in the interior and lower portions of the watershed. Paul and Woolfenden (1985) summarize the birds of the Tampa Bay estuary.

For our discussion, the avifauna have been divided into the following six guilds, based on general similarities in habitat use:

1. Forest arboreal birds.
2. Wading birds.
3. Floating and diving water birds.
4. Birds of prey.
5. Probing shorebirds.
6. Aerially searching birds.

This scheme has been adopted since it seems more descriptive than other schemes such as Robertson and Kushlan's (1974) broad delineation between land birds and water birds. The latter scheme divides water birds into seabirds, birds of estuarine and coastal wetlands, and species of interior wetlands.

6.5.1 Forest (Arboreal) Birds

This category includes the true forest-dwelling birds, some of which may also frequent the forest edge and other inland habitats such as wet prairies, sawgrass marshes, urban environments, and agricultural lands. Taxonomically, this guild of birds consists largely of the perching birds (order Passeriformes) as well as members of the orders Galliformes (turkey, bobwhite), Columbiformes (pigeons and doves), Cuculiformes (cuckoos and anis), Caprimulgiformes (nighthawk and chuck-wills-widow), Apodiformes (swifts and hummingbirds), and Piciformes (woodpeckers).

The arboreal avifauna of the Tampa Bay watershed (Appendix Tables A-18 through A-20) is estimated at approximately 165 species. This consists of a core of about 47 year-round residents as well as three other species groups: (1) the exclusively winter residents, with 53 species; (2) the exclusively summer residents,

Table 42. Amphibians and reptiles of biological significance.

Species	Reason for status as significant
Amphibians	
Lesser siren (*Siren intermedia*)	At southern limit of its range
Dwarf siren (*Pseudobranchus striatus*)	Taxonomic uncertainty; wetland dependence
Southern dusky salamander (*Desmognathus auriculatus*)	Narrow habitat requirements; at southern limit of range
Slimy salamander (*Plethodon glutinosus*)	Narrow habitat requirements; at southern limit of range
Dwarf salamander (*Eurycea quadridigitata*)	At southern limit of range
Eastern spadefoot toad (*Scaphiopus holbrooki*)	Narrow habitat preference when not breeding
Giant toad (*Bufo marinus*)	Potentially negative effect on native fauna
Cuban treefrog (*Osteopilus septentrionalis*)	Potentially negative effect on native fauna
Bullfrog (*Rana catesbeiana*)	At southern limit of range
Pig frog (*Rana grylio*)	Commercially valuable
Green frog (*Rana clamitans*)	At or beyond southern limit of known range
Florida gopher frog (*Rana capito*)	Listed by FCREPA as threatened
Reptiles	
American alligator (*Alligator mississippiensis*)	Listed by FCREPA as threatened
Spotted turtle (*Clemmys guttata*)	Listed by FCREPA as rare; at southern range limit
Box turtle (*Terrapene carolina*)	Intergradational populations taxonomically significant
Diamondback terrapin (*Malaclemys terrapin*)	Mangrove quality indicator species
Suwannee cooter (*Chrysemys floridana*)	Listed by FCREPA as threatened
Gopher tortoise (*Gopherus polyphemus*)	Listed by FCREPA as threatened
Atlantic green turtle (*Chelonia mydas mydas*)	Listed by FCREPA as endangered
Atlantic loggerhead (*Caretta caretta caretta*)	Listed by FCREPA as threatened
Kemp's ridley (*Lepidochelys kempii*)	Listed by FCREPA as endangered
Atlantic leatherback (*Dermochelys coriacea coriacea*)	Listed by FCREPA as endangered
Florida softshell turtle (*Trionyx ferox*)	Commercially valuable; biological interest re: breathing physiology
Green anole (*Anolis carolinensis*)	Presence of morphologically different populations
Eastern fence lizard (*Sceloporus undulatus*)	At southern range limit
Florida scrub lizard (*Sceloporus woodi*)	Listed by FCREPA as rare; narrow habitat requirement
Broad-headed skink (*Eumeces laticeps*)	At southern range limit
Mole skink (*Eumeces egregius*)	Listed by FCREPA as threatened; of evolutionary interest
Blue-tailed mole skink (*Eumeces egregius lividus*)	Listed by FCREPA as threatened; of evolutionary interest
Sand skink (*Neoseps reynoldsi*)	Listed by FCREPA as threatened; narrow habitat requirements
Worm lizard (*Rhineura floridana*)	Endemic genus at southern range limit
Banded water snake (*Nerodia fasciata fasciata*)	Wetland-quality indicator species; sensitive
Striped crayfish snake (*Regina alleni*)	Wetland dependent, eats crayfish extensively
Black swamp snake (*Seminatrix pygaea*)	Southern and northern races intergrade
Florida red-bellied snake (*Storeria occipitomaculata obscura*)	At extreme southern limit of range
Southern hognose snake (*Heterodon simus*)	At southern limit of range
Pine Woods snake (*Rhadinaea flavilata*)	At southern range limit; habitat specificity
Eastern indigo snake (*Drymarchon corais couperi*)	Listed by FCREPA as threatened
Short-tailed snake (*Stilosoma extenuatum*)	Listed by FCREPA as endangered; endemiomonotypicgenus
Florida crowned snake (*Tantilla relicta*)	At southern range limit; two races present, habitat specific
Pigmy rattlesnake (*Sistrurus miliarius*)	Wet prairie indicator species

with 9 species; and (3) the migrating or transient birds with 50 species. Robertson and Kushlan (1974) note that approximately 60% of the total south Florida avifauna is migratory.

An additional 20 to 30 species of arboreal birds not listed in Appendix Table A-16 are reported, but considered accidental in the study area. These include those escapees (i.e., exotic parrots and parakeets) now living in the wild and vagrant birds that occasionally wander into the area. The former include such species as the canary-winged parakeet (*Brotogeris versicolurus*), the monk parakeet (*Myiopsitta monachus*), and the budgerigar (*Melopsittacus undulatus*), which now actively breed in South Florida. The latter include a mixture of species such as the horned lark (*Eremophilla alpestris*), rufous hummingbird (*Selasphorus rufus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), and eastern meadowlark (*Sturnella magna*) more typical of the midwestern United States, and the spotted-breasted oriole (*Icterus pectoralis*), smooth-billed ani (*Crotophaga ani*), and Bahama swallow (*Tachycineta cyaneoviridis*) of Caribbean origin.

Historically and ecologically, the south Florida Peninsula represents a relatively unfavorable area for the proliferation of arboreal birds. In addition to the paucity of true terrestrial habitats, the area is regarded as climatically unstable in the long-term geological sense. These factors, along with the relative isolation of the peninsula, are believed to be the major reasons for a relatively depauperate arboreal fauna in south Florida. Robertson and Kushlan (1974) summarize the situation as follows:

> In our view, southern Florida (and to a diminishing degree northward, the entire southeast) exists today as a sort of avifaunal vacuum, the hiatus between a continental land avifauna withdrawing before an unfavorable climatic trend and a West Indian land avifauna delayed in reaching vacant and suitable habitat by a sea barrier and perhaps also by intrinsic qualities that make island birds poor colonizers of mainland areas.

The "unfavorable climatic trend" refers to the sea-level fluctuations of the Pleistocene, which alternately drained and flooded the south Florida Peninsula. This trend is graphically expressed in Figure 124, which shows 55 to 60 species of arboreal birds using the study area for breeding purposes. Farther north as many as 65 to 70 breeding species are observed. This north-south trend is especially pronounced with respect to the passerine birds, while the number of nonpasserine species compares fairly well to other locations in the same latitude.

While these numbers describe a rather clear trend, they do not tell the full story, particularly with regard to the effect of season upon species composition and abundance. Summer is the time of minimum arboreal bird use in south Florida. Most of the approximately 27 migratory species breed somewhere farther north during these months, so few would be expected in the study area. The number of species breeding during the summer is also low (9–19), approximately 30% to 60% fewer than during the winter. Noteworthy among these breeders are the approximately eight summer-only residents such as the nighthawk and the eastern kingbird. In addition to lower species numbers during the summer, the actual density of individuals is also lower than in winter. In winter, species

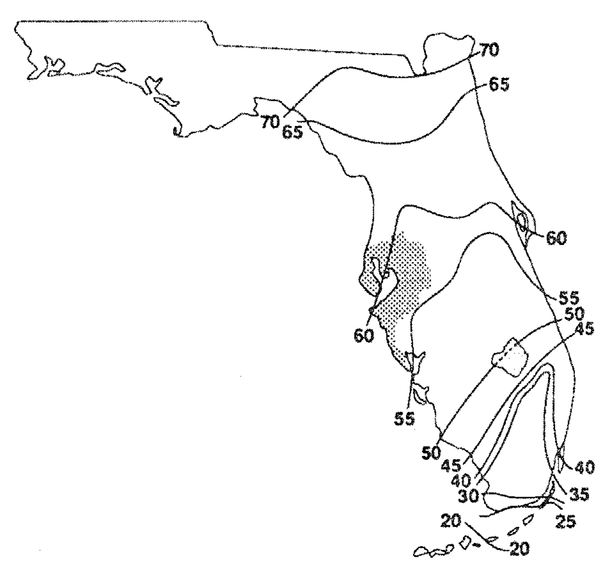


Figure 124. Number of species of breeding land birds in the Florida Peninsula (after Robertson and Kushlan 1974).

diversity and bird density increase significantly. The South Florida Research Center (1980) lists 44 species of winter-only residents.

With regard to habitat use by both resident and migratory species, the most commonly used communities appear to be pinelands and cypress or mixed swamp forests. This is probably a function of food supply (primarily insects and seeds) and structural diversity.

In a quantitative study on bird communities in the watershed, Hirth and Marion (1979) record 49 arboreal species from a flatwoods area north of the Manatee River. Vegetation was a mixture of slash pine, saw palmetto, and grassland, dotted with occasional live oak hammocks along small streams.

Of the 49 species, 32 were permanent residents, 13 were winter-only residents and 4 were summer-only residents. Consistent with the above general trends, the total number of species was high in the fall and winter and low in spring and summer.

Trophically speaking, granivores dominated during the summer while insectivores dominated in the winter. Compared to granivores and insectivores, relatively few omnivores and carnivores were observed. Table 43 presents a list of species by season and their trophic categories.

The most important ground-feeding insectivore during all seasons was the eastern meadowlark. Canopy-feeding insectivores (e.g., pine and palm warblers) were abundant in the winter. During the

Table 43. Species and feeding strategies of forest birds using flatwoods in the Tampa Bay area (adapted from Hirth and Marion 1979)

Species and feeding strategies	Season[a]
Granivores	
Northern bobwhite (*Colinus virginianus*)	P
Rufous-sided towhee (*Pipilo erythrophthalmus*)	P
Red-winged blackbird (*Agelaius phoeniceus*)	P
Mourning dove (*Zenaida macroura*)	P
Northern cardinal (*Cardinalis cardinalis*)	P
Common ground-dove (*Columbina passerina*)	P
Bachman's sparrow (*Aimophila aestivalis*)	P
Savannah sparrow (*Passerculus sandwichensis*)	W
Song sparrow (*Melospiza melodia*)	W
Omnivores	
Common grackle (*Quiscalus quiscula*)	P
Boat-tailed grackle (*Q. major*)	P
Blue jay (*Cyanocitta cristata*)	P
Northern mockingbird (*Mimus polyglottos*)	P
American robin (*Turdus migratorius*)	W
Brown-headed cowbird (*Molothrus ater*)	W
Insectivores	
Eastern meadowlark (*Sturnella magna*)	P
Red-bellied woodpecker (*Melanerpes carolinus*)	P
Common yellowthroat (*Geothlypis trichas*)	P
Eastern bluebird (*Sialia sialis*)	P
Carolina wren (*Thryothorus ludovicianus*)	P
Loggerhead shrike (*Lanius ludovicianus*)	P
Insectivores (cont.)	
Red-headed woodpecker (*Melanerpes erythrocephalus*)	P
Cattle egret (*Bubulcus ibis*)	P
Brown-headed nuthatch (*Sitta pusilla*)	P
Downy woodpecker (*Picoides pubescens*)	P
Pileated woodpecker (*Dryocopus pileatus*)	P
Red-cockaded woodpecker (*Picoides borealis*)	P
Northern flicker (*Colaptes auratus*)	P
Pine warbler (*Dendroica pinus*)	P
Palm warbler (*D. palmarum*)	W
Short-billed marsh wren (*Cistothorus platensis*)	W
Tree swallow (*Iridoprocne bicolor*)	W
Common nighthawk (*Chordeiles minor*)	S
Eastern kingbird (*Tyrannus tyrannus*)	S
Purple martin (*Progne subis*)	S
Great crested flycatcher (*Myiarchus crinitus*)	S
Carnivores (birds of prey)	
Turkey vulture (*Cathartes aura*)	P
Red-tailed hawk (*Buteo jamaicensis*)	P
Belted kingfisher (*Ceryle alcyon*)	P
Black vulture (*Coragyps atratus*)	P
Red-shouldered hawk (*Buteo lineatus*)	P
Marsh hawk (*Circus cyaneus*)	W

[a] P = Permanent Resident; W = Winter Resident; S = Summer Resident

summer, woodpeckers and brown-headed nuthatches became the second most abundant insectivores. Most of the granivores were ground feeders (i.e., bobwhite, dove) owing to the extent of grassland habitat. Cardinals and towhees were common in the brushier habitats. Two birds, the rufous-sided towhee and the white-eyed vireo, are particularly abundant in scrubby flatwoods.

6.5.2 Wading Birds

A total of 19 species of wading birds, mostly herons (order Ciconiiformes) and some cranes and their allies (order Gruiformes), from this group are found in the Tampa Bay watershed (Appendix Table A-21). Like the arboreal avifauna, the interior wetland-dependent avifauna is considered to have a low number of species. From the interior wetlands of nearby Cuba, 26 species are reported, as compared to 19 species from south Florida. The explanation for this phenomenon is similar to that for arboreal avifaunal impoverishment. The long-term sea-level fluctuations of the Pleistocene have created, in the south Florida peninsula, an unreliable freshwater wetland habitat that has been both periodically submerged and considerably drier than at present. In contrast, saltwater and brackish wetlands have been much more constant. It is not surprising, therefore, that Robertson and Kushlan (1974) speculate that this area is probably best exploited by mobile populations of wading birds, most of which are also, and perhaps primarily, estuarine. Consistent with this view is the fact that the coastal and estuarine avifauna is essentially identical to the coastal and estuarine avifauna elsewhere in the region. Robertson and Kushlan (1974) hypothesize that breeding wading birds move into and exploit freshwater wetlands when conditions promote their feeding and reproductive needs. Relatively few species (e.g., cattle egret, white ibis, and woodstork) actually appear to prefer freshwater nesting sites to brackish ones. In drought or flood years, the birds tend to rely on the more stable productivity of the mangrove zone (Odum et al. 1982). Superimposed onto these natural trends are coastal and wetland development, which may force some species to seek out less than optimal breeding and feeding habitats.

In recent times (the last 150 years), wading bird numbers have fluctuated widely due to a combination of factors, some natural and some human-induced. Robertson and Kushlan (1974) estimate that in 1870, south Florida supported a population of approximately 2,500,000 wading birds. By the early 1900's the population had been reduced to around 500,000, mostly due to direct harvesting by plume hunters. Another generally less important factor was early coastal development that eliminated some nesting habitat. The species that probably suffered the most from plume hunting was the roseate spoonbill. Although it is listed in Appendix Table A-21 as occurring in the Tampa Bay area, its distribution in south Florida is currently limited to Florida Bay.

When commercial hunting ceased, the wetland bird populations began to increase, reaching a new peak of around 1.2 million birds by 1935. In the background, however, the agricultural and urban development of south Florida was beginning in earnest. Within a period of 25 years, considerable wading-bird habitat was consumed as water-control structures were built and wetlands drained, crops planted, and coastal cities built. By 1940 an estimated total of only 300,000 wading birds remained in south Florida. More recently, this downward trend appears to have stabilized at around 125,000 to 130,000 (Robertson and Kushlan 1974; Kushlan and White 1977).

Table 44 presents a summary of the total numbers of nests of wading birds observed in the Tampa Bay area from 1976 to 1978. Because of variations in timing and intensity of breeding coupled with sampling inconsistencies, these numbers cannot be used as accurate population estimates. However, the numbers do indicate relative levels of density and breeding activity for the study area.

The growth, reproduction, and maintenance of wading-bird populations depend upon the area's capacity to produce the necessary fish and other foods. In this regard, both the availability of physical habitat (shallow wetlands) and suitable hydrologic conditions (amount of rainfall and seasonality) are essential factors. The first factor is essential for adequate fish production, in that shallow ponds, marshes, wet prairies, or sloughs are important for

Table 44. Number of wading bird nests by county in the Tampa Bay watershed from 1976 to 1978 (adapted from Nesbitt et al. 1982).

	County					
Common name	Pasco	Pinellas	Sarasota	Manatee	Hillsborough	Total
Cattle egret	450	1,237	35	3,200	12,300	17,222
White ibis	—	17	—	1,250	9,230	10,497
Wood stork	—	—	—	—	150	150
Great egret	—	586	100	700	184	1,570
Snowy egret	—	+	100	200	502	802
Great blue heron	—	79	29	88	47	243
Little blue heron	—	25	—	100	349	474
Tricolored heron	+	+	—	50	400	450
Glossy ibis	—	—	—	+	300	300
Green heron	—	—	—	—	7	7
Black-crowned night heron	—	—	—	—	400	400
Yellow-crowned night heron	—	1	—	—	314	315
Roseate spoonbill	—	—	—	—	15	15

+ = present but uncounted.

producing large populations of small fish and crayfish.

In general, the biggest threats to this linkage between fish and birds are the mining of wetlands for phosphate rock, the draining of wetlands for agricultural development, and suburban development in and around wetlands. On the positive side, however, of 20 nesting sites identified in Polk County, 6 were located in reclaimed phosphate mines and 6 were located in water impoundments. Only eight were located in natural habitats. This reflects a combination of forces and responses by wading bird populations to adapt to changing or altered situations. In order to survive in this changing environment, wading-bird species must possess the flexibility to exploit these new habitats. Although the relative species abundance and composition may be affected, it is encouraging that wading birds show sustained usage of mining sites reclaimed as wetlands (Nesbitt et al. 1982). Sites reclaimed to deep lakes or pastures do not exhibit the same degree of wildlife value.

Farther downstream, in estuarine waters, Schreiber and Schreiber (1978) note a similar trend in the use of dredged-spoil islands by nesting waders. On older, "mature" islands with trees and shrubs, the canopy layer may be heavily used by great blue herons, great egrets, and woodstorks. The subcanopy layer is more attractive to green herons, little blue herons, tricolored herons, reddish egrets, black- and yellow-crowned night herons, white ibis, glossy ibis, and roseate spoonbills. All of these species need to be left undisturbed during their breeding seasons and many need shallow areas for feeding. Many spoil islands are lacking in one or both of these characteristics.

6.5.3 Floating and Diving Water Birds

A list of 46 floating and diving water birds that use habitats of the Tampa Bay watershed appears in Appendix Table A-22 (TI 1978c). Members of this guild come from five taxonomic orders: the pelicans and their allies (Pelecaniformes), the waterfowl (Anseriformes), the gallinules and coot (Gruiformes), the loons (Gaviiformes), and the grebes (Podicipediformes).

The pelicans are represented by two species, the brown (*Pelecanus occidentalis*) and the white (*P. erythrorhynchos*). Aside from the obvious morphologic differences between the two, the brown and white differ in their methods of feeding. The brown pelican dives from a height of about 10 meters for small fish in estuarine and nearshore waters. An accomplished glider, this bird is frequently seen skimming along only a few centimeters above the surface of the water. The white pelican, on the other hand, does not dive at all, but feeds in shallow waters by scooping up fish with its large bill. Whereas brown pelicans seldom soar, the white pelicans may be seen at great heights migrating in large V-shaped formations. White pelicans also inhabit freshwater lakes, unlike the more exclusively marine brown pelicans (Nesbitt et al. 1982).

Two other important members of this order are the double-crested cormorant (*Phalacrocorax auritus)* and the anhinga (*Anhinga anhinga).* Both species are fish eaters that dive from the surface and swim underwater. It is generally thought that the cormorant prefers coastal waters, while the anhinga is exclusively a freshwater species. However, Nesbitt et al. (1982) report numerous cormorants nesting almost exclusively in the freshwater wetlands of Polk County, and anhingas may nest on barrier islands.

The waterfowl (family Anatidae) consist of eight subfamilies. Two of these subfamilies, the swans (subfamily Cygninae) and the geese (subfamily Anserinae), are not included in the following discussion. Visits to the Tampa Bay area by members of these two groups are rare and accidental.

Surface-feeding ducks (subfamily Anatinae) include the mallard, black duck, mottled duck, wood duck, teals, shoveler, American wigeon, gadwall, and pintail. These ducks do not generally dive, but rather tip up vertically to feed on vegetation, infauna, and small fish in shallow waters. Most of these species move between fresh and brackish waters, while a few (wood duck and American wigeon) prefer fresh water. Most of these ducks are winter residents only. However, according to Sprunt (1954), the Florida duck (*Anas fulvigula fulvigula),* a subspecies of the mottled duck, is a permanent year-round resident of peninsular Florida.

Tree ducks, or whistling ducks, (subfamily Dendrocygninae) are represented by the shy fulvous whistling duck, which feeds nocturnally on both aquatic and terrestrial vegetation. Like surface-feeding ducks, they tip and feed from the surface.

Bay ducks (subfamily Aythyinae) include the scaup, redhead, ring necked duck, and bufflehead. These ducks seem to prefer protected coastal bays and river mouths for their wintering grounds. Unlike the surface feeders, bay ducks dive beneath the water surface where they swim in search of food. Generally they eat more animal food than the surface feeders.

Stiff-tailed ducks (subfamily Oxyurinae) are represented by only one occasional species, the ruddy shelduck. This small, stubby duck sits rather low in the water and dives for its predominantly animal food. It appears in Florida from late October to early May.

Mergansers (subfamily Merginae) are represented by the red-breasted merganser, the common merganser, and, infrequently, the hooded merganser. The mergansers have long, thin bills, modified for seizing fish while they swim beneath the surface. The red-breasted merganser seldom comes to inland water bodies, preferring the coastal waters instead. As with other migratory ducks, the mergansers are found only during the winter months.

Factors affecting waterfowl populations in the study area have been investigated by Gasaway and Drda (1977), Montalbano et al. (1978, 1979), Gasaway et al. (1979), Wenner (1979), Schnoes and Humphrey (1980), and Maehr (1981). The percentage and type of vegetation cover, as well as the presence of grass carp (*Ctenopharyngodon idella),* have been shown to influence waterfowl production. The presence of water hyacinths, though good for fish and invertebrate production, is not desirable for ducks and coots (Duke and Chabreck 1976). However, hydrilla (*Hydrilla verticillata)* has been shown to provide a substantial portion of the diet of omnivorous ducks (Montalbano et al. 1979). Through its indirect effects on hydrilla, the grass carp has been shown to degrade waterfowl habitat (Gasaway and Drda 1977; Gasaway et al. 1979), by reducing other vegetation and invertebrate and fish populations. Properly reclaimed phosphate mines may prove to be very useful waterfowl habitat (Gilbert et al. 1981).

The cranes and their allies (order Gruiformes) are represented by three of the most abundant floating and diving water birds of the Florida gulf coast, the common gallinule, the purple gallinule, and the American coot. These birds, which are permanent residents, exhibit characteristics somewhat intermediate between wading birds and floating birds. It is not uncommon to see gallinules and coots feeding along the edges of shallow waters, sometimes wading, sometimes floating. Their diet consists of a mixture of aquatic insects, benthic infauna, and vegetation. As it is with the omnivorous ducks, *Hydrilla* proves to be a very significant food source for the coot (Montalbano et al. 1979). The common and purple gallinules tend to be found in freshwaters only during the nesting season, moving to brackish waters during the winter months.

Another resident floating and diving water bird is the pied-billed grebe (family Podicipediformes). The pied-billed grebe is a small bird that prefers shallow freshwaters and rarely moves into brackish areas. Its diet consists of about half fish and crayfish and the other half insects (Sprunt 1954). An accomplished swimmer and rather poor flyer, it frequently escapes danger overhead by diving. The grebe nests from mid-April to September. Increased numbers of birds in the winter indicates that there is some migration of the population.

The last group of floating and diving birds is the family Gaviidae (loons), of which only one species, the common loon, occurs with any seasonal regularity. Arriving in late October or early November and departing by April or May, the common loon spends most of its time in coastal bays. An exceptional swimmer, the loon spends nearly all its time in the water, where it feeds exclusively on fish. The loon characteristically swims very low to the water giving its head and neck a roughly S-shaped profile. Just before diving the loon hops upward to gain momentum as it lunges under the surface.

6.5.4 Birds of Prey

A total of 27 species of birds from three orders comprise the members of this guild within the study area (Appendix Tables A-23 through A-25). Twenty species of the order Falconiformes (hawks, eagles, and vultures) are included in this group, along with six species of owls (order Strigiformes), and the magnificent frigatebird (order Pelecaniformes).

The vultures (family Cathartidae) are represented by two species, the turkey vulture and the black vulture. Their seemingly effortless gliding takes them over virtually all habitats in search of carrion. Despite the fact that they spend much of their time cleaning up road kills, they are seldom the victim of such accidents. The turkey vulture is more abundant than the black vulture.

Another species that frequently associates with vultures in south Florida is the crested caracara (*Polyborus planeus*). This bird, a member of the Falconidae family, is a subtropical species having the greater part of its range farther west in Mexico and Central America. Like the vultures, it feeds on carrion, though it flies much less and tends to restrict itself to open prairies, agricultural lands, and scrub habitats.

Another group of predatory birds that uses a broad range of habitats are the members of the Accipitridae family (hawks and eagles). The swallow-tailed kite, the red-tailed hawk, the red-shouldered hawk, and the short-tailed hawk are primarily forest dwellers, preferring to nest in cypress, pine, or oak trees. The largest of the four, the red-tailed hawk, feeds predominantly upon small mammals (meadow mice), reptiles, insects, and crawfish. Small birds make up another 10% of its diet. As its prey suggests, this bird is a frequent visitor to upland prairies and marshes as well as forests. The swallow-tailed kite prefers a combination of prairies, open pine glades, and cypress. Its food, primarily snakes, lizards, dragonflies, and grasshoppers, is taken on the wing. The relatively small red-shouldered hawk is the most abundant and widely distributed of the four. Its diet consists of small mammals, snakes, lizards, frogs, and insects. The short-tailed hawk, although a resident and breeder in Florida, is relatively uncommon. The greater part of its range is located in Central and South America.

Among predatory birds that restrict themselves to a narrower range of upland habitats are the Cooper's hawk and the broad-winged hawk, which appear to prefer upland forests; the kestrel, which appears to prefer open uplands; and the Everglades kite, which exclusively uses wet prairies and sawgrass marshes. The Cooper's hawk is considered fairly uncommon throughout all of Florida. The kestrel or sparrow hawk and the broad-winged hawk rely heavily upon insects as prey, while the Cooper's hawk preys on smaller birds, mammals, and reptiles. The Everglades kite, not a permanent resident of Tampa Bay, is a rather specialized subspecies that feeds exclusively upon the apple snail (*Pomacea* sp.), found in abundance in sawgrass marshes.

A fourth group of Accipitridae includes two species that prefer open areas in both marine and freshwater settings. The marsh hawk is a common species in salt marshes and is seen to a lesser extent in upland marshes and prairies. The marsh hawk is primarily a rodent eater, consuming mice, rabbits, and particularly cotton rats (*Sigmodon hispidus).* Some birds, such as the clapper rail and bob white, are also taken. The other member of this group is the merlin or eastern pigeon hawk, an uncommon, usually winter-only resident. It is primarily a bird-eating hawk, taking shorebirds, pigeons, doves, and flickers, as well as some insects and small mammals.

A fifth group contains two members, the sharp-shinned hawk and the peregrine falcon, which are also bird-eating hawks. These birds prefer coastal habitats within the watershed, but utilize freshwater marshes and sloughs as well. Both are considered only occasional winter residents.

The sixth group includes two species that are predominantly coastal in habitat preference, the osprey (family Pandonidae) and the bald eagle (family Accipitridae). The origin of this preference, which is clearly stronger for the osprey than the eagle, is their dependence upon an aquatic food source. Both birds depend heavily upon fish. The osprey is a striking and efficient predator, snatching fish from the water surface with its feet. The eagle, while fishing in a similar manner, is better known for its habit of robbing osprey of their prey. The larger eagle generally harasses the osprey in flight until the latter drops its prey. The eagle then catches the fish in the air, leaving the osprey without its food.

Finally the last group, the owls (order Strigiformes) are represented by six species. Three of these, the screech, barred, and great horned owl are forest-dwelling species. All are well adapted to forest hunting, with large sensitive ears and eyes and silent flight. The smaller screech owl tends to be more restricted to upland woods than the other two species. The larger barred and great horned owls are more commonly known from wet hammock and swamp forest habitats. Three other owls, the barn, burrowing, and short-eared owls prefer to hunt in open country. The long legs of the barn owl are useful in capturing prey in marshes and prairies. The Florida burrowing owl (*Athene cunicularia floridana)* originates from the tropics, reaching the northern limits of its range in northern Florida. All owls are top carnivores, feeding on a combination of small mammals, amphibians, reptiles, and occasionally even large insects.

6.5.5 Probing Shorebirds

The term "probing shorebirds" is a somewhat misleading label for this guild of birds (Appendix Table A-26). Although most of these species frequent either shoreline or estuarine habitats while in the watershed, many others do not. This is particularly true when the total range and life history of each species is considered. A majority of these species are either winter-only species or migrating transients and use the food resources found in shallow subtidal and intertidal habitats. During other seasons in other parts of their ranges, many of these birds use freshwater wetlands for nesting and feeding. In the final analysis it is the combination of two factors, predominantly coastal habitat utilization and the most common mode of feeding, which is used to define this group. Nonetheless, some birds of this guild exhibit significant variations in their mode of feeding, placing them somewhere between the waders and probers. Examples include the greater yellowlegs and clapper rail.

Five members of this guild, namely, the clapper rail, king rail, Virginia rail, sora, and blackrail, belong to the order Gruiformes. The remaining birds all belong to the order Charadriiformes. These include the oyster catchers (family Haematopodidae); the plovers, turnstones, and surf-birds (family Charadriidae); the sandpipers (family Scolopacidae); and the avocets (family Recurvirostridae).

It has been suggested (Recher 1966; Green 1968) that among the probing shore birds, morphological differences in bill length and structure are an important resource-partitioning factor. Such differences are believed to reduce competition between species by functionally segregating the infaunal food resources into fractions for which different bill lengths and structures are best suited. However, operation of this principal for birds feeding in the same habitat, where competition should be greatest, has not been demonstrated. In California, wintering shallow-feeding birds (avocets, western sandpiper, dunlin, and dowitcher) all fed on the same things (Quammen 1982). It is unknown if the morphological differences in bills evolved for breeding grounds or wintering areas.

Other factors such as feeding behavior, flexibility in diet, and the use of other habitats also contribute to this partitioning. Peterson and Peterson (1979) distinguish two categories of probers, the shallow-probing and surface-searching shorebirds, and the deep-probing shorebirds. This delineation is based on fundamental differences in feeding habits and diets.

Shallow probers are generally very opportunistic feeders, taking whatever prey presents itself in greatest numbers. Consequently, their diets may vary widely depending upon their location. Experiments conducted elsewhere along the Atlantic coast (Schneider 1978) have shown that shallow probers can have a very significant effect on the composition and abundance of intertidal and beach fauna. Quammen (1982) found changes in intertidal and beach faunal abundance but not species composition on the Pacific coast. The importance of this effect in Florida is unknown. Since many of these birds are winter-only residents or migratory species, their predatory effect is likely to be greatest in winter. This is the time of greatest abundance for many infaunal invertebrate prey, such as polychaetes, amphipods, and bivalve mollusks.

In addition to morphological differences, the shallow probers also differ among themselves in feeding strategies. Some, such as the plovers and smaller sandpipers, feed by sight, commonly preying upon surface fauna in sea wrack or sand. Others, such as the semipalmated sandpiper and sanderling, feed by truly probing in the substrate. Their bills are intricately innervated with sensory nerves that facilitate prey capture. Preferences for prey organisms may also play a role in resource partitioning by virtue of minimizing spatial overlap between species. Certain species, such as the ruddy turnstone, tend to prefer hard substrates that support their favorite prey. Others, such as the clapper rail, stick to the higher ends of salt marshes, only occasionally venturing out onto mudflats at low tide.

Two species, the longbilled and shortbilled dowitchers, belong somewhere between the shallow- and deep-probing categories. Although their bills are long, they often take the same food and frequently feed more like the shallow probers than the deep probers (Quammen 1982). Another species, the American oystercatcher, feeds when possible on oysters and other large mollusks. For this reason it is hard to place the oyster-catcher in either category.

The deep-probing shorebirds include such species as the willet, the marbled godwit, and the long-billed curlew. Their long bills enable them to reach deeper into the sediment to obtain a different food source. Their generally greater size also allows them to take larger prey. The most common deep prober in the beach environment is clearly the willet. Although this bird does probe for its own food, it more often exhibits aggressive behavior toward other probing shorebirds, often appropriating their prey or chasing them away.

6.5.6 Aerially Searching Birds

Although the birds of this guild (Appendix Table A-27) are regarded as primarily estuarine, many of them frequent a variety of other habitats as well. One species, the belted kingfisher, prefers the freshwater wetland habitat. The gull most commonly found inland is the ringbilled gull. The herring, laughing, and Bonaparte's gulls tend to be strictly coastal and venture only occasionally around inland lakes, agricultural fields, or dump sites. The terns tend to restrict themselves to coastal habitats. Some, like Forsters tern, are regularly reported from Lake Okeechobee, but they more commonly occur in coastal embayments, marsh and mangrove ponds, and offshore waters. The black skimmer, probably because of its unique fishing tactics, tends to be found in large bodies of calm waters both inland and coastal. When skimming is not possible, the bird has been known to wade and probe for small fishes in shallow pools. The fish crow, though it is often found near water, prefers neither estuarine nor freshwater habitats.

Food habits for this group follow two main lines, a heavy dependence on fish, and considerable omnivory. The acrobatic terns are the more fish-dependent group of birds within the guild, hovering 20–30 m above the water in search of surface-feeding fishes. When prey is sighted they make spectacular dives into the water. Prey selectivity is probably a function of the size of the bird and the available fish. The Caspian tern, being the largest tern, has been known to take mullet, menhaden, and sardines. Smaller birds such as the least tern no doubt select smaller species or juvenile fishes. Also a fish eater is the belted kingfisher, which may be seen perching on cypress branches or power lines above roadside ditches. When the kingfisher locates a likely prey, it dives down into the water much as the terns do. Because of its unique anatomy and mode of feeding, the black skimmer is also dependent almost exclusively upon a fish diet.

Gulls are scavengers. They make use of beaches, mudflats, open bays, offshore waters, inland lakes, fields, marshes, and even urban settings. Some of their most conspicuous gathering centers are landfills. Along the coast their diet consists of fish, insects, and other small marine fauna. At inland settings they feed opportunistically on soil arthropods, possibly earthworms and, at landfills, garbage. The use of inland habitats appears to be seasonal and associated with adverse weather. Gulls seem to move inshore more often, almost diurnally, during the winter months. The winter months also correspond to the time of highest numbers of gulls in the watershed. During or just before storms, gulls tend to move inshore many kilometers, probably in search of shelter.

Many of the 10 gull species listed in Appendix Table A-27 visit the study area only during the winter. The more common are the ringbilled gull, Bonaparte's gull, and the herring gull. The laughing gull is the only true year-round resident. Both its summer and winter range incorporate Tampa Bay.

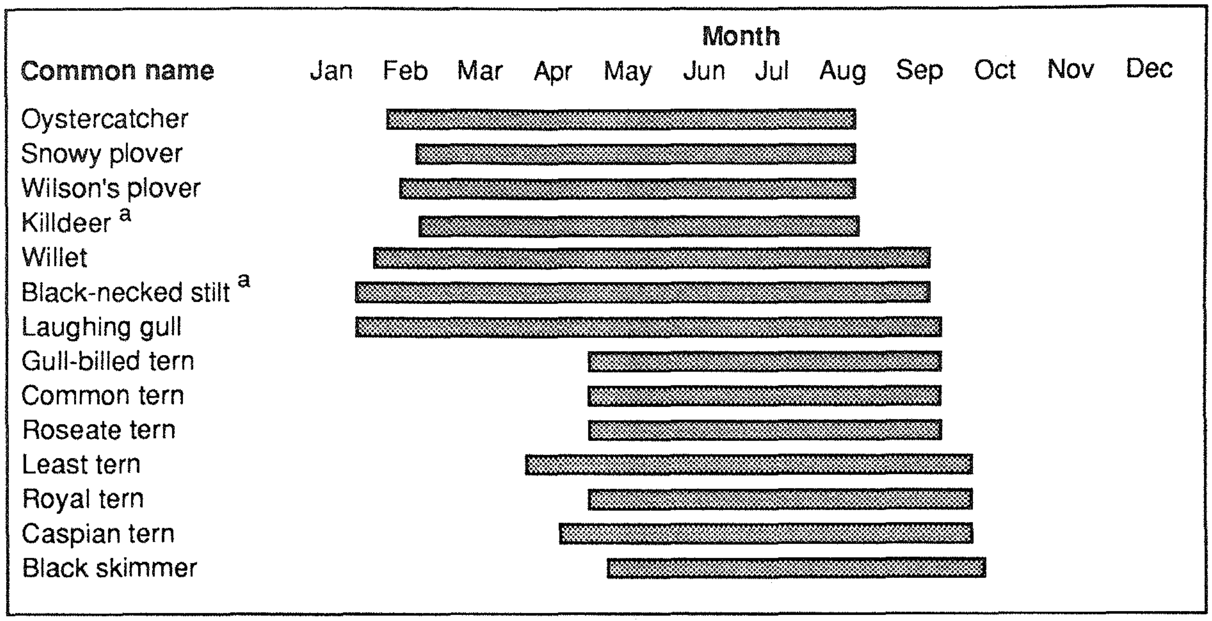
Breeding populations of laughing gulls in the Tampa Bay-Charlotte Harbor area have been identified by Dinsmore and Schreiber (1974) and Schreiber and Schreiber (1979, 1980). The large increase in numbers of gulls from the mid-1960's to the mid-1970's has been associated with the increased food availability provided by garbage dumps in the area.

Laughing gulls usually nest between April and September (Clap et al. 1983), with peak egglaying in May. Laughing gulls have been reported nesting on dredge-spoil islands in Tampa Bay by Schreiber and Schreiber (1978).

Probably the most omnivorous bird of this guild is the fish crow, which belongs to this guild by virtue of its predilection of searching for unattended nests in rookeries of herons, ibises, and other seabirds. If eggs are present the fish crow will prey upon them. Other components of its diet include small fishes, crabs, shrimp, mollusks, and numerous types of wild fruit including palmetto berries, dogwood, sour gum, red bay, and others. Turtle eggs have also been recorded as part of their diet.

Nesting patterns of colonial shorebirds in the study area have been studied by Schreiber and Schreiber (1978) (Figure 125), particularly with regard to their use of dredged spoil islands. The openness and low shrubbery of such islands are attractive nesting habitats for many birds of this guild. The presence of attractive nesting habitat, however, does not necessarily insure its use by birds. In contrast to the tree-nesting colonial wading birds, very few of the ground-nesting shorebirds intermingle, though they may simultaneously use the same island (Figure 125).

The Florida Committee on Rare and Endangered Plants and Animals (Kale 1978) lists 44 taxa of birds



[a] *Not yet found on dredged material Islands, but included here for completeness*

American oystercatcher
– snowy plover
– – Wilson's plover
– – – willet
– – – – laughing gull
– – – – – east tern
– – – – • – royal tern
– – – – • – • Caspian tern
– – – – – – – – black skimmer

– Nest on same island in close association.
• Nest on same island, but not usually intermingled.

Figure 125. Nesting patterns of colonial shorebirds on Flòrida spoil islands (adapted from Schreiber and Schreiber 1978).

from the Tampa Bay watershed (Table 45). This list includes all of the wading birds plus a number of species that depend on beaches and coastal wetlands. Cumulative habitat alteration is one of the primary reasons for the decline of many of these species. Still other factors that enhance the decline of certain species are their naturally limited range within the state and their specialized feeding or nesting habitat requirements. The Florida scrub jay and the Everglades kite are two good examples of species suffering because of habitat destruction combined with an inflexible set of food and habitat requirements.

6.6 Mammals

Appendix Tables A-28 through A-30 present 53 taxa of mammals that are known or expected to be found in terrestrial, wetland, and aquatic habitats in the Tampa Bay watershed. Ten of these species are marked with an (E) to designate their status as exotics. The nine-banded armadillo is considered an exotic by Layne et al. (1977), although it has naturally invaded the Florida panhandle from the west. The 39 native species of mammals represent 80% of the total number of mammalian species in Florida. Virtually

Table 45. Birds designated as endangered (E), threatened (T), rare (R), or of special concern (SC) by Kale (1978).

Common Name (Scientific Name)	Status	Common Name (Scientific Name)	Status
Wood stork (*Mycteria americana)*	E	Short-tailed hawk (*Buteo brachyurus)*	R
Florida Everglade kite (*Rostrhamus sociabilis plumbeus)*	E	Mangrove cuckoo (*Coccyzus minor)*	R
Peregrine falcon (*Falco peregrinus)*	E	Black-whiskered vireo (*Vireo altiloquus)*	R
Cuban snowy plover (*Charadrius alexandrinus tenuirostris)*	E	Great egret (*Casmerodius albus)*	SC
Ivory-billed woodpecker (*Campephilus principalis)*	E	Little blue heron (*Florida caerulea)*	SC
Red-cockaded woodpecker (*Picoides borealis)*	E	Snowy egret (*Egretta thula)*	SC
Florida grasshopper sparrow (*Ammodramus savannarum floridanus)*	E	Tricolored heron (*Hydranassa tricolor)*	SC
Cape Sable seaside sparrow (*Ammospiza maritimus mirabilis)*	E	Black-crowned night heron (*Nycticorax nycticorax)*	SC
Eastern brown pelican (*Pelecanus occidentalis carolinensis)*	T	Yellow-crowned night heron (*Nyctanassa violaceus)*	SC
Magnificent frigatebird (*Fregata magnificens)*	T	Least bittern (*Ixobrychus exilis exilis)*	SC
Bald eagle (*Haliaeetus leucocephalus)*	T	Glossy ibis (*Plegadis falcinellus)*	SC
Osprey (*Pandion haliaetus)*	T	White ibis (*Eudocimus albus)*	SC
Southeastern American kestrel (*Falco sparverius paulus)*	T	Cooper's hawk (*Accipiter cooperii)*	SC
Crested caracara (*Polyborus planeus)*	T	Limpkin (*Aramus guarauna)*	SC
Florida sandhill crane (*Grus canadensis pratensis)*	T	Piping plover (*Charadrius melodus)*	SC
American oystercatcher (*Haematopus palliatus)*	T	Royal tern (*Sterna maxima)*	SC
Least tern (*Sterna antillarum)*	T	Sandwich tern (*Sterna sandvicensis)*	SC
Florida scrub jay (*Aphelocoma coerulescens coerulescens)*	T	Black skimmer (*Rynchops niger)*	SC
Reddish egret (*Dichromanassa rufescens)*	R	Florida burrowing owl (*Athene cunicularia floridana)*	SC
Roseate spoonbill (*Ajaia ajaja)*	R	Southern hairy woodpecker (*Picoides villosus auduboni)*	SC
White-tailed kite (*Elanus leucurus)*	R	Marian's marsh wren (*Cistothorus palustris marianae)*	SC
		Florida prairie warbler (*Dendroica discolor paludicola)*	SC

all of the native species listed are of North America origin. This essentially unimpaired range extension of a temperate fauna into the subtropics accompanies what appears to be an extensive differentiation of some species populations into many races. Such differentiation is believed to result from the frequent isolation of populations and subsequent genetic drift during fluctuating sea levels of the late Pleistocene (Layne 1974, 1978), rather than adaptation resulting from invasion into unexploited subtropical habitats.

According to Layne et al. (1977), the mammalian fauna of the watershed is of interest in several respects. A portion of the Tampa Bay area forms part of the Central Florida Highland biogeographic region, one of seven major biogeographic regions of Florida recognized by Neill (1957). This region, which includes the ridge section of Polk County, is characterized by endemic species restricted to the xeric sand pine scrub and sandhill habitats. The Florida mouse (*Peromyscus floridanus*) is a member of this endemic species group.

A rather large number of species (20%) reach their southern limits in western peninsular Florida within the study area. These include the southeastern shrew, Rafinesque's big-eared bat, big brown bat, southeastern pocket gopher, eastern harvest mouse, Florida mouse, golden mouse, and eastern woodrat.

Two subspecies, the mole (*Scalopus aquaticus bassi)* and cotton mouse (*Peromyscus gossypinus* *restrictus)*, were originally described from the Tampa Bay area. The type localities are Englewood and Chadwick Beach (Sarasota County), respectively. The Chadwick Beach cotton mouse is known only from that locality, and its present status is uncertain. Part of the range of another coastal subspecies with a greatly restricted distribution, the insular cotton rat (*Sigmodon hispidus insulicola)*, also extends into the Tampa Bay area. The zone of intergradation between Sherman's fox squirrel (*Sciurus niger shermani)* and the mangrove fox squirrel (*S. niger avicennia)* may also lie in the study area. Finally, the seven-county region of Layne et al.'s (1977) study area is in the transition zone between north Florida with relatively many bat species and south Florida with relatively few.

Regarding the exotic species of the region, apparently the only established population of coyotes in Florida exists in Polk County, and nutria colonies in dairy farm ponds near Brandon, Hillsborough County, may represent the densest populations of this introduced species in the state.

In addition to land mammals, two species of aquatic marine mammals are also considered part of the total mammalian fauna. The first of these, the manatee, frequents both fresh and estuarine waters. A number of factors determine whether a particular site is suitable for manatee use, including availability of vascular aquatic vegetation for food, proximity to channels at least 2 m deep, recourse to warm water during cold snaps, and a source of freshwater.

Estimates of the Tampa Bay manatee population vary from 40 to 55 animals, with the highest numbers reported in the winter months (Hartman 1974; Patton 1980; Irvine et al. 1981). An additional 14 to 35 manatees may remain outside the bay, widely scattered in the surrounding coastal area.

Patton (1980) demonstrated that most of the bay population aggregated around artificial warm-water areas in winter (e.g., power plant thermal discharge sites), with many individuals being found in the Alafia, Manatee, and Little Manatee Rivers. Descriptions of this winter aggregation have resulted in the Alafia River being designated as a sanctuary under the Florida Manatee Sanctuary Act of 1980.

Reynolds and Patton (1985) recently reviewed manatee-related research and conservation efforts for these protected animals in Tampa Bay. Specific programs and study needs are outlined which, in their opinion, are needed to better understand and manage the manatee population in the area.

The manatee is a strict herbivore with no known predators. It appears that cold weather, shoreline development, injuries from boat collisions, and possibly pollution are among the major factors limiting the survival of manatees in Florida.

The bottle-nosed dolphin is strictly marine and estuarine in its distribution. Its primary source of food is mullet. Offshore of Tampa Bay, Reynolds and Patton (1985) estimate a population of 78 year-round residents with another 200 individuals just north and south of the bay area. These animals appear to be in herds of two to three animals that are fairly evenly distributed from nearshore to 24 km offshore. In Tampa Bay, numbers appear to be lower (around 23), although the survey coverage was admittedly inadequate. Irvine et al. (1981) note that dolphin numbers in and adjacent to Tampa Bay increase from July to November. A localized herd of around 102 individuals is reported from Sarasota Bay (Wells et al. 1980; Irvine et al. 1982). Reynolds and Patton (1985) note that Tampa Bay dolphins commonly harbor a parasite that rarely appear in dolphins elsewhere in Florida.

Other marine mammals not considered residents of the study area, but occasionally observed alive or found stranded in Tampa Bay and nearby waters, include 10 species of whales and 8 species of dolphins (Table 46). Two of the eighteen species listed (Table 47), the humpback whale and the sperm whale, are currently on the federal endangered species list. These pelagic animals, more commonly associated with deeper oceanic waters adjacent to or beyond the Continental Shelf, are generally considered rare in the northeastern gulf.

Increased interest and research efforts have, however, shown that some species are more common than previously thought. For example, the pygmy sperm whale, once considered to be very rare, has been stranded several times around Tampa Bay, and is now considered to be the second most commonly stranded

Table 46. Marine mammals sighted or stranded in Tampa Bay and in Gulf of Mexico coastal waters between Pasco and Sarasota counties. Numbers represent events, not total number of animals involved (from Schmidly 1980, SEAN1980–1982, Reynolds and Patton 1985).[a]

Common Name (Species Name)	Number of Strandings	Number of Sightings
Bryde's whale (*Balaenoptera edeni*)	1	0
Humpback whale[b] (*Megaptera novaeangliae*)	0	1
Sperm whale[b] (*Physeter catodon*)	1	0
Pygmy sperm whale (*Kogia breviceps*)	5	0
Dwarf sperm whale (*K. simus*)	1	0
Goose-beaked whale (*Ziphius cavirostris*)	2	0
Pygmy killer whale (*Feresa attenuata*)	1	0
False killer whale (*Pseudorca crassidens*)	0	1
Killer whale (*Orcinus orca*)	0	1
Short-finned pilot whale (*Globicephala macrorhynchus*)	7	1
Rough-toothed dolphin (*Steno bredanensis*)	1	0
Saddle-backed dolphin (*Delphinus delphis*)	0	1
Risso's dolphin (*Grampus griseus*)	1	0
Bridled dolphin (*Stenella frontalis*)	0	1
Atlantic spotted dolphin (*S. plagiodon*)	3	1[c]
Striped (Euphrosyne) dolphin (*S. coeruleoalba*)	1	0[c]
Spinner dolphin (*S. longirostris*)	3	0

a Table 1 does not include strandings or sightings of the bottle-nosed dolphin (*Tursiops truncatus*) or of the Florida manatee (*Trichechus manatus latirostris*).
b Listed as endangered (Wood1989).
c Indicates species for which numerous sightings have been made offshore of the survey area.

cetacean in Florida, after the bottle-nosed dolphin (Odell et al. 1981). Additional information on marine mammal strandings and sightings from the Tampa Bay area may be found in Schmidley (1980) and the SEAN (Scientific Event Alert Network) reports 1975–1982.

Layne (1978) lists nine taxa of mammals from the study area as either endangered, threatened, rare, of special concern, or status undetermined (Table 47). Notable among these are four of the larger mammals, the panther, the black bear, and two species of weasel (*Mustela*). Due probably to food requirements and territorial imperatives, these four taxa generally thrive only where there is a large amount of open space supporting a mixture of appropriate habitats. Besides these 9, an additional 24 species are considered of commercial value or special biological significance (Neill 1957).

Table 47. Mammals of special concern in the Tampa Bay watershed (adapted from Layne 1978).

Common name	Reason for status as significant
Virginia opossum	Commercially valuable fur.
Southeastern shrew	Rare (FCREPA).
Short-tailed shrew	Biological indicator of forested wetlands.
Big brown bat	Rare (FCREPA).
Northern yellow bat	Indicator of open woodlands with mature trees.
Rafinesque's big-eared bat	Rare (FCREPA).
Nine-banded armadillo	Rapidly spreading invader.
Marsh rabbit	Game species.
Eastern cottontail	Game species.
Gray squirrel	Game species.
Sherman's fox squirrel	Threatened (FCREPA).
Southeastern pocket gopher	Reaches southern range limit.
Eastern harvest mouse	Reaches southern range limit.
Florida mouse	Threatened (FCREPA).
Golden mouse	Habitat specificity.
Eastern wood rat	Reaches southern range limit; forested wetlands indicator species.
Roundtailed muskrat	Species of special concern (FCREPA).
Nutria	Rapidly spreading invader.
Bottle-nosed dolphin	Estuarine quality indicator.
Coyote	New invader with unknown potential.
Red fox	New invader with unknown potential.
Gray fox	Sport and commercial fur-bearing species.
Florida black bear	Threatened (FCREPA).
Raccoon	Game species; commercial fur-bearer.
Florida long-tailed weasel	Rare (FCREPA).
Striped skunk	Commercially valuable fur-bearer.
River otter	Protected fur-bearer.
Florida panther	Endangered (FCREPA).
Bobcat	Indicator organism.
Manatee	Endangered (FCREPA).
Wild hog	Game species.
White-tailed deer	Game species.

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Appendix Table A-1. Cenozoic units and formations underlying the Tampa Bay watershed.

Series	Formation and *References* [a]	Lithology	Location
Holocene	recent (≤4500 yrs. B.P.) *1,2.*	Undifferentiated sand, shell, clay, marl, peat.	Most significant deposits are represented by the barrier islands from Anclote Keys to Manasota Peninsula.
Pleistocene	Fort Thompson Group *1.*	Clastic and shell deposits associated with the Pamlico (+8m), Talbot (+13m), and Penholoway (+19m), middle and early Pleistocene sea level stands and the late Pleistocene Princess Anne.	Mainland coastline for all study areas except barrier islands, and western Pinellas County and portions of coastal Hillsborough Bay.
	Caloosahatchee *1,3,4,5.*	Calcareous, shelly sand with diverse extinct tropical marine fauna, may contain multiple, very hard, sandy cap rocks.	In an approximate circle, 10 km in diameter, centered in St. Petersburg, Florida.
Plio-Pleistocene	Undifferentiated #1 *1,6.*	Preglacial Pleistocene, lagoonal and prograded unlithified coastal sand; shelly, silty, gray to greenish-gray sand; fossiliferous; contains "Pine-crest" fauna (Pinecrest Sand member of the Tamiami Formation).	Contained in band which runs parallel to south Hillsborough County, Manatee County, and Sarasota County coastlines.
	Undifferentiated #2 *1.*	Residual and reworked white, pure quartz sand with little to no heavy minerals.	Adjacent and parallel to the undifferentiated #1 strata. Includes northeast tip of Sarasota County, middle Manatee County, south-central Hillsborough County, and patches in Plant City and middle Alafia River.
Pliocene	Tamiami *24.*	Discontinuous permeable sand, gravel, shell, limestone, and dolomitic beds.	Thins out over and interbedded with Hawthorn Formation. Underlies the coastal area from Sarasota south, and extends 10 to 12 miles inland.
	Bone Valley *1,7,8,9,10,11,12,13, 14,15.*	Pebbly and clayey sands composed of quartz and clastic phosphate. Sand and clay fine-grained, calcareous to noncalcareous, fossiliferous; abundant phosphorite nodules up to gravel size; white to gray in upper part, amber to black in lower part; beds of clean phosphate sand, and sand and gravel. Two units—upper: leached or weathered, green clayey sand, minor apatite; particles finely bedded, grade-bedded and cross-bedded; montmorillonite clay weathered to kaolinite at top; aluminum phosphate. Lower unit: green, phosphoritic; sand, clay and gravel with abundant phosphate particles, calcium phosphate, the phosphate ore "matrix" zone, crude bedding.	Found in southeast Hillsborough County, northeast Manatee County and western Polk County in Alafia River's North and South Prongs. Average thickness 30 to 40 feet, although much greater in karst depressions which surmount the Hawthorne Formation.

Continued.

Appendix Table A-1. Concluded.

Miocene	Hawthorne *1,5,10,11,12,14,15, 16,17,18,19, 20,21.*	Highly variable mixture of silts, clays, sands, limestone, dolomite, and phosphate. Typically a silty, sandy, phosphatic dolomite; yellowish-gray to white; microcrystalline to very fine. Limestone white or occasionally yellowish-gray to very pale orange, calcilutite crytocrystalline to microcrystalline, sandy, clayey, phosphatic and dolomitic. Clay; yellowish-gray to light green to moderately dark gray, quartz silt and sand, micritic, dolomitic, phosphatic. Sand, light gray to very pale orange to dusky yellow-green; very fine to medium, angular to subangular, silty, phosphatic. As many as three units recognized in the Tampa area. An upper sand unit, a middle phosphatic clay unit, and a lower limestone unit. Middle unit is often combined with upper, lower, or both. Brooks (1982a) identified 5 facies statewide, three of which exist in the Tampa area.	Northern boundary from Dunedin to N. Old Tampa Bay to middle Hillsborough Bay to Polk City. Dips to south, southeast and southwest; max height exceeds 100 ft MSL in SE Hillsborough County, and dips to greater than -100 ft MSL around Tampa Bay Harbor mouth. Generally thickens to south, thickest in band from Sarasota to ENE county line.
Miocene	Tampa (St. Marks) *1,5,10,11,12,14,15, 16,17,18,19, 20,21,22,23.*	Quartz sand limestone; soft to hard; white, light yellow, tan to gray; occasionally the upper portion contains calcareous sands and clays which grade downward to unconsolidated or loosely cemented lime mud; upper portion contains chert layers, silicified fossils, and occasional phosphate nodules or pebbles; very porous. Sandy, green and gray clay. Fine to very fine quartz sand. High density and diversity of fossils; includes corals, echinoids, ostracods, foraminiferans and mollusks.	Underlies most of the study area. Pinched out to north where Suwannee limestone surfaces. Dips to WSW; attains maximum elevation in extreme NE study area (50' MSL), minimum elevation (-350' MSL) in vicinity of Tampa Harbor mouth and City of Sarasota. Surfaces in NW Hillsborough, N Pinellas, and SE Pasco County. Outcrops in Hillsborough R., Ballast Pt., and Interbay Peninsula. Few feet to 200 ft thick.

[a] **References**

1) Brooks 1982a
2) Davis 1946
3) Doyle 1982
4) Cooke 1945
5) Heath and Smith 1954
6) Hunter 1978
7) Cathcart et al. 1953
8) Altschuler et al. 1964
9) Puri and Vernon 1964
10) Vernon and Puri 1964
11) Wright 1974
12) Dames and Moore 1975
13) TI 1978a
14) Knapp 1980
15) Scott and MacGill 1981
16) Carr and Alverson 1959
17) Peek 1959
18) Menke et al. 1961
19) Hutchinson and Stewart 1978
20) King and Wright 1979
21) Deuerling and MacGill 1981
22) Wetterhall 1964
23) Mann 1972
24) Brown 1982b

Appendix Table A-2. Point-source emission summary for west-central Florida (after TI 1978a).

County	Category	Year	TSP t/yr	SO_2 t/yr
Hillsborough	Phosphate	74	5,279	25,175
		76	2,262	17,875
	Electric	74	20,069	234,823
		76	3,831	213,218
	Misc.	74	4,010	7,623
		76	1,816	7,555
	Total	74	29,358	267,620
		76	7,909	238,649
Manatee	Phosphate	74	104	628
		76	42	1,674
	Electric	76	276	3,801
	Misc.	74	295	118
		76	295	118
	Total	74	399	746
		76	614	5,593
Polk	Phosphate	74	30,033	110,171
		76	6,809	37,149
	Electric	74	204	7,998
		76	295	6,987
	Misc.	74	889	841
		76	1,023	944
	Total	74	31,125	119,010
		76	8,127	45,080
Sarasota	Misc.	74/76	115	175
Total four county area	Phosphate	74	35,416	135,974
		76	9,113	56,698
	Electric	74	20,273	242,821
		76	4,402	224,006
	Misc.	74	5,309	8,757
		76	3,249	8,792
	Total	74	60,998	387,552
		76	16,764	289,496

Appendix Table A-3. Summary of point- and areal-source emissions in west-central Florida (after TI 1978a).[a]

County		1974 Particulates(TSP)	1974 SO_2	1976 Particulates(TSP)	1976 SO_2
		Total emissions (t/yr)			
Hillsborough	Areal sources	12,382	2,559	12,865	2,695
	Point sources	29,358	267,620	7,909	238,649
Manatee	Areal sources	3,091	326	3,121	348
	Point sources	399	746	614	5,593
Polk	Areal sources	10,983	841	11,199	901
	Point sources	31,125	119,010	8,127	45,080
Sarasota	Areal sources	2,806	328	2,901	349
	Point sources	115	175	115	175
Total	Areal sources	35,297	4,332	36,176	4,580
	Point sources	61,095	387,790	16,863	289,736
	All sources	96,392	392,122	53,039	294,316

[a]Pinellas County was not included in this survey.

Appendix Table A-4. Areal source emissions of particulates and SO_2 in west-central Florida (after TI 1978a).

	1974				1976			
	TSP		SO_2		TSP		SO_2	
Source category	t/yr	ton/yr	t/yr	ton/yr	t/yr	ton/yr	t/yr	ton/yr
				Hillsborough County				
Mobile sources								
Highway	2,582	(2,840)	817	(849)	2,739	(3,013)	876	(954)
Aircraft	70	(77)	106	(117)	77	(85)	118	(130)
Vessels	66	(73)	789	(868)	66	(73)	789	(868)
Railroad	109	(120)	249	(274)	120	(132)	275	(302)
Off-highway	83	(91)	103	(113)	88	(97)	110	(121)
Stationary fuel combustion								
Natural gas	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-
Coal	225	(248)	484	(532)	233	(256)	525	(577)
Liquid petroleum gas	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-
Burning								
Trash incineration	7.3	(8)	4.5	(5)	7.3	(8)	4.5	(5)
Forest fires, agriculture	991	(1,090)	-	-	991	(1,090)	-	-
Other sources								
Citrus heating	45	(50)	6.4	(7)	45	(50)	6.4	(7)
Fugitive dust	3,353	(3,688)	-	-	3,353	(3,688)	-	-
Paved roads	4,851	(5,336)	-	-	5,146	(5,661)	-	-
Total	12,382	(13,621)	2,559	(2,765)	12,865	(14,153)	2,704	(2,964)
				Manatee County				
Mobile sources								
Highway	369	(406)	116	(128)	391	(430)	124	(136)
Aircraft	10	(11)	15	(17)	11	(12)	17	(19)
Vessels	5.4	(6)	67	(74)	5.4	(6)	67	(74)
Railroad	1.8	(2)	4.5	(5)	1.8	(2)	45	(5)
Off-highway	18	(20)	21	(23)	20	(22)	23	(25)
Stationary fuel combustion								
Natural gas	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-
Coal	48	(53)	98	(108)	53	(58)	108	(119)
Liquid petroleum gas	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-
Burning								
Trash incineration	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	690	(759)	-	-	690	(759)	-	-
Other sources								
Citrus heating	17	(19)	2.7	(3)	17	(19)	2.7	(3)
Fugitive dust	1,234	(1,357)	-	-	1,234	(1,357)	-	-
Paved roads	693	(762)	-	-	693	(809)	-	-
Total	3,091	(3,400)	326	(360)	3,121	(3,479)	388	(383)

Continued.

Appendix Table A-4. Concluded.

Source category	1974 TSP t/yr	1974 TSP ton/yr	1974 SO_2 t/yr	1974 SO_2 ton/yr	1976 TSP t/yr	1976 TSP ton/yr	1976 SO_2 t/yr	1976 SO_2 ton/yr
Polk County								
Mobile sources								
Highway	1,121	(1,233)	355	(390)	1,189	(1,308)	376	(414)
Aircraft	3.6	(4)	1.8	(2)	4.5	(5)	2.7	(3)
Vessels	-	-	-	-	-	-	-	-
Railroad	61	(67)	140	(154)	68	(75)	155	(170)
Off- highway	43	(47)	51	(56)	46	(51)	54	(59)
Stationary fuel combustion								
Natural gas	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-
Coal	116	(128)	225	(248)	124	(136)	245	(270)
Liquid petroleum gas	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-
Burning								
Trash Incineration	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	1,705	(1,876)	-	-	1,705	(1,876)	-	-
Other sources								
Citrus heating	345	(380)	66	(73)	345	(380)	61	(73)
Fugitive dust	5,478	(6,026)	-	-	5,478	(6,026)	-	-
Paved roads	2,106	(2,317)	-	-	2,235	(2,458)	-	-
Total	10,983	(12,083)	841	(925)	11,199	(12,320)	895	(991)
Sarasota County								
Mobile sources								
Highway	514	(565)	163	(179)	545	(599)	173	(190)
Aircraft	-	-	-	-	-	-	-	-
Vessels	-	-	-	-	-	-	-	-
Railroad	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)
Off- highway	22	(24)	27	(30)	23	(25)	29	(32)
Stationary fuel combustion								
Natural gas	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-
Coal	65	(71)	132	(145)	69	(76)	141	(155)
Liquid petroleum gas	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-
Burning								
Trash Incineration	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	544	(599)	-	-	544	(599)	-	-
Other sources								
Citrus heating	1.8	(2)	-	-	1.8	(2)	-	-
Fugitive dust	688	(757)	-	-	688	(757)	-	-
Paved roads	965	(1,061)	-	-	1,024	(1,126)	-	-
Total	2,806	(3,086)	328	(361)	2,901	(3,191)	349	(384)

Appendix Table A-5. Municipal, domestic, and industrial dischargers in the lower Hillsborough River watershed (after Priede-Sedgwick, Inc. 1980; Hartigan and Hanson-Walton 1984).

Name	Design[a]/ADF[b] (mgd)	Facility activity	Immediate receiving waters
Juanita Apartments	0.01/0.004	Domestic	Hillsborough Bay
Hookers Point	60.0/53.0	Domestic	Hillsborough Bay
General Portland, Inc.	[c]- /0.01	Bulk Cement Terminal	Hillsborough Bay
General Portland, Inc.	- /0.07	Bulk Cement Terminal	Hillsborough Bay
American Can Company	- /0.27	Can Fabrication	Hillsborough Bay
American Oil Company	- /0.0008	Terminal	Hillsborough Bay
American Petrofina Company	- / -	Terminal	Hillsborough Bay
City Service Oil Company	- /0.0001	Terminal	Hillsborough Bay
Del Monte Corporation	- /0.121	Food Processor	McKay Bay
MacDill Defense Fuel Facility	- / -	Terminal	Hillsborough Bay
MacDill Fighter Support Facility	- / -	—	Hillsborough Bay
Murphy Oil Company	- / -	Terminal	Hillsborough Bay
Phillips Petroleum Company	- / -	Terminal	Hillsborough Bay
City of Tampa - Water Treatment Plant	- / -	Alum. Sludge Ponds	Hillsborough River
TECO - Hooker's Point Station	- /225.5	Power Plant	Hillsborough Bay
Texaco, Inc.	- / -	Terminal	Hillsborough Bay
S.T. Tringali Company	- /0.0015	Seafood Processing	Hillsborough Bay
Union Carbide Corporation	- / -	Bulk Facility	Hillsborough Bay
Union Oil Company	0.087/ -	Terminal	Hillsborough Bay
Winn Dixie Stores	- /0.033	Warehouse	Hillsborough River

[a]Design capacity.
[b]Average flow.
[c](-)=not in permit

Appendix Table A-6. Domestic and industrial dischargers in the Tampa Bypass Canal drainage system (after Priede-Sedgwick, Inc. 1980; HCEPC 1982; Hand 1983; Hartigan and Hanson-Walton 1984).

Name	Design/ADF (mgd)	Facility activity	Immediate receiving waters
Eastside Water Company	0.29/0.25	Domestic STP	Palm River
Adamo Acresy	0.27/0.10	Domestic STP	Six Mile Creek
Williams Oil Company	0.013/0.005	Domestic STP	Six Mile Creek
Davies Can Company	- /0.009	Can Fabrication	Palm River
Kaiser Chemical Company	- /0.028	Chemical Manufacturer	Six Mile Creek
Seaboard Coastline RR	0.325/0.464	Rail Yard	Palm River
MRI Corporation	- / -	Chemical Manufacturer	Six Mile Creek

Appendix Table A-7. Industrial dischargers in the Alafia River watershed (after Priede-Sedgwick, Inc. 1980; Hartigan and Hanson-Walton 1984).

Name	Design/ADF	(mgd)[a]	Immediate Facility activity	Receiving Waters
Florida Dairy	[b]- / -		Feed lot	Hillsborough Bay
Gardinier, Inc.	- /66.3		Chemical manufacturer	Hillsborough Bay
Agrico Chemical Company	- / -		Phosphate milling	Alafia River - North Prong
Agrico Chemical Company	- / -	(1.4)	Mine	Alafia River - South Prong
Borden, Inc.	- /4.26		Big Four Mine	Alafia River - South Prong
Borden, Inc.	- / -		Coronet Mine	English Creek
Brewster Phosphate	0.005/ -	(43.7)	Haynesworth Mine	Alafia River - South Prong
Brewster Phosphate	- /14.57	(5.5)	Fort Lonesome Mine	Alafia River - South Prong
C.F. Chemicals, Inc.	- /3.32	(4.6)	Phosphate complex	Alafia River
Conserv	- /14.0	(3.6)	Mine	Thirty Mile Creek
Electro-Phosphate Corp.	- / -		Chemical manufacturer	Alafia River - North Prong
Estech General Chemical Corp.	- /1.8	(N.D.)	Silver City Mine	Alafia River - South Prong
Farmland Industries	- /3.27	(2.9)	Chemical manufacturer	Alafia River - North Prong
W.R. Grace & Company	- /10.09	(22.9)	Chemical manufacturer	Alafia River - South Prong
W.R. Grace & Company	- /4.67		Chemical manufacturer	Alafia River
W.R. Grace & Company	- /6.68	(6.0)	Chemical manufacturer	Alafia River - North Prong
Hopewell Land Corp.	- /4.42		Recovery plant	Alafia River
IMC Corporation	- /1.44		Chemical manufacturer	Alafia River - South Prong
IMC Corporation	- /6.70	(0.6)	Kingsford Mine	Alafia River - South Prong
Mid-Florida Phosphate Corp.	- / -		Chemical manufacturer	Alafia River - North Prong
Mobile Chemical Company	- /12.9	(19.1)	Nichols Mine	Thirty Mile Branch
Mobile Chemical Company	- / -		Chemical manufacturer	Thirty Mile Branch
Seaboard Coastline Railroad	- /0.017		Freight car yard	Winston Creek
T/A Minerals	- / -		Sands and rock mining	Alafia River - North Prong
Royster		(0.43)	Chemical manufacturer	Alafia River - South Prong
Amax		(1.84)	Big Four Mine	Alafia River - South Prong
IMC Corporation		(10.7)	Noralyn/Phosphoria Mine	Alafia River - South Prong

[a]Data from Hartigan and Hanson-Walton (1984) survey.
[b](-) = not reported

Appendix Table A-8. Summary of 1982 and 1983 Tampa Bay water-quality characteristics (after HCEPC 1984).

Parameter[a]	Old Tampa Bay (N=17)[b]	Hillsborough Bay (N=14)[b]	Middle Tampa Bay (N=12)[b]	Lower Tampa Bay (N=11)[b]
BOD	[c]2.1/2.6	3.5/2.3	2.3/2.0	1.3/1.2
	[d]1.9-2.9/2.2-3.7	2.0-4.9/1.3-3.2	1.3-3.7/1.5-3.0	0.9-1.6/0.8-1.7
TOC	7.3/6.6	8.3/7.8	7.3/5.6	4.8/3.7
	6.4-8.8/5.3-8.0	6.3-10.8/6.3-11.3	6.0-9.2/4.6-6.2	3.5-6.3/2.8-5.0
Chlorophyll *a*	13.5/17.5	29.1/23.6	16.4/18.3	6.0/7.4
	10.8-16.9/14.2-24.9	11.5-44.5/10.8-29.5	7.5-33.2/10.6-30.6	4.7-7.7/5.2-11.0
FC	62/45	301/179	44/5	39/3
(col./100 ml)	49-117/4-298	42-2880/3-1123	39-54/3-14	39-40/2-6
TC	92/92	661/323	54/10	40/3
(col./100 ml)	52-324/7-728	55-6464/8-2167	40-76/4-15	39-43/2-6
Color	12/15	21/24	12/13	6/6
(Pt-Co Units)	10-17/12-19	14-34/17-42	8-16/9-18	4-8/3-8
Cond. (Surf.)	39/33	37/30	42/37	49/47
(x1000)	35-42/26-35	25-41/20-35	40-45/35-41	46-52/43-51
Depth	11/10	9.9/9.8	17.0/18.0	19/20
(feet)	4-19/4-21	4.2-24.1/4.7-24.2	6.0-29.0/6.8-29.5	6.8-32.4/6.9-31.6
Light Penetration	54/52	36/40	60/61	92/87
(inches)	30-77/37-68	29-47/32-46	37-83/42-75	67-111/60-110
Fluoride	1.1/0.9	1.2/1.1	1.3/1.0	1.2/1.0
	1.1-1.2/0.8-1.0	1.1-1.4/0.8-1.2	1.2-1.4/1.0-1.1	1.1-1.3/1.0-1.1
Ammonia	0.06/0.07	0.12/0.14	0.07/0.08	0.06/0.06
	0.05-0.08/0.05-0.10	0.08-0.23/0.08-0.24	0.05-0.08/0.06-0.10	0.05-0.07/0.05-0.09
Kjeldahl	0.65/0.92	0.99/1.14	0.66/0.87	0.42/0.60
Nitrogen	0.54-0.80/0.74-1.13	0.85-1.19/0.91-1.28	0.44-1.05/0.67-1.22	0.36-0.56/0.51-0.72
Nitrate	0.02/0.02	0.08/0.16	0.02/0.02	0.01/0.01
	0.01-0.04/0.01-0.03	0.02-0.38/0.04-0.56	0.01-0.03/0.01-0.05	0.01-0.02/0.01-0.01
Organic	0.59/0.85	0.87/1.00	0.60/0.78	0.36/0.53
Nitrogen	0.49-0.73/0.68-1.08	0.68-1.08/0.82-1.09	0.42-0.98/0.63-1.14	0.29-0.50/0.44-0.66
Total	0.67/0.94	1.08/1.24	0.68/0.78	0.43/0.61
Nitrogen	0.56-0.82/0.76-1.17	0.86-1.30/0.94-1.65	0.44-1.08/0.63-1.14	0.37-0.57/0.52-0.73
DO (top)	7.9/6.7	7.6/7.1	8.1/7.3	7.5/6.9
	7.4-8.6/5.6-7.5	4.6-9.4/5.2-8.8	7.3-9.3/6.5-7.8	7.0-8.1/6.2-7.8
DO (bottom)	7.5/6.3	5.9/5.1	7.0/6.1	7.2/6.4
	5.4-8.2/4.0-7.0	2.6-7.2/2.4-6.5	6.0-8.6/5.1-7.5	6.5-8.0/6.0-7.3
pH	7.9-8.9/7.1-8.2	7.7-8.9/7.3-8.0	7.7-8.8/7.6-8.3	7.5-8.3/7.7-8.5
Total	0.37/0.42	0.66/0.80	0.38/0.49	0.17/0.20
Phosphate	0.32-0.62/0.38-0.48	0.40-1.35/0.46-1.78	0.18-0.57/0.33-1.11	0.09-0.38/0.10-0.31
Salinity (top)	25/20	24/18.6	27/24	32/30
(ppt)	22-27/16-22	16-26/12-22	26-29/22-26	30-34/28-34
Salinity (bottom)	25/20	25/21.4	28/25	33/31
(ppt)	22-27/17-23	18-27/19-24	26-31/23-29	31-35/29-34
Temp (middle)	22/24	23/24	23/24	24/24
(°C)	22-23/24-25			
Turbidity	4.6/4.1	7.4/5.3	4.8/4.3	3.8/4.3
(NTU)	2.8-7.6/2.8-5.9	5.2-12.6/3.9-8.5	3.2-9.0/2.5-7.2	3.1-7.5/3.0-7.4

[a] mg/L unless otherwise indicated, [b] number of sampling stations
[c] = mean 1982/mean 1983, [d] = range 1982/range 1983

Appendix Table A-9. Aquatic macrophytes collected from the Alafia and Little Manatee Rivers (adapted from Dames and Moore 1975).

Common name / *Scientific name*	Sampling Stations[a,b] Alafia River —> Upstream —>					Little Manatee River —> Upstream —>				
	A2	**A3**	**A4**	**A5**	**A6**	**LM2**	**LM3**	**LM4**	**LM5**	**LM6**
Algae										
Stonewort										
Chara sp.	-	-	•	-	-	-	-	-	-	-
Bryophytes										
Fissidens										
Fissidens sp.	-	•	•(2)	•(1)	•(2)	-	-	-	-	-
Vascular Plants										
Cattail										
Typha sp.	•(1)	-	-	-	-	-	-	-	-	-
Bur reed										
Sparganium sp.	-	-	•	-	-	-	-	-	-	-
Water-thread pondweed										
Potamogeton diversifolius	-	-	-	-	•	-	-	•	•(2)	•(2)
Bushy pondweed										
Najas flexilis	-	•(1)	•(1)	-	-	-	-	-	-	-
Dwarf burhead										
Echinodorus parvulus	-	-	-	-	-	-	•	-	-	-
Water plantain										
Alisma sp.	-	-	-	-	-	-	•	-	-	-
Arrowhead										
Sagittaria sp.	-	-	•	-	-	-	-	-	-	-
Waterweed										
Elodea canadensis	-	•(2)	•(3)	-	-	-	-	•(1)	•(1)	•(1)
Spikerush										
Eleocharis acicularis	-	•	-	-	•	-	-	•	-	-
Minute duckweed										
Lemna perpusilla	-	•	•	-	•	-	-	-	•	•
Water-hyacinth										
Eichhornia crassipes	•	•	-	-	-	•(2)	•(1)	-	-	-
Southern pickerelweed										
Pontederia cordata var. *lanceolata*	-	-	-	-	-	-	•(2)	-	-	-

Continued.

Appendix Table A-9. Concluded.

Common name / *Scientific name*	Sampling Stations[a,b] Alafia River —> Upstream —>					Little Manatee River —> Upstream —>				
	A2	**A3**	**A4**	**A5**	**A6**	**LM2**	**LM3**	**LM4**	**LM5**	**LM6**
Rush *Juncus* sp.	•(2)	-	-	-	-	-	•(1)	-	-	-
Smartweed *Polygonum sp.*	-	•	•	-	•	-	-	-	•	•
Coontail *Ceratophyllum demersum*	-	-	•	•(2)	•(3)	-	-	-	-	•(3)
Yellow water lily *Nymphaea mexicana*	-	-	-	-	-	-	•(3)	•(3)	-	-
St. John's-wort *Hypericum boreale*	-	•	•	-	•	-	-	•(2)	-	-
Water purslane *Ludwigia* sp.	-	-	•	-	-	-	-	-	-	-
Water-milfoil *Myriophyllum heterophyllum*	-	•(3)	-	-	-	-	-	-	-	-
Centella *Centella erecta*	-	-	-	-	-	-	-	-	-	•
Water pennywort *Hydrocotyle umbellata*	-	-	-	•(3)	•	-	•	•	•	•
Hedge hyssop *Gratiola ramosa*	-	-	-	-	•	-	-	-	-	-
Water marigold *Megalodontia beckii*	-	-	•	-	•(1)	-	-	-	-	•
Unidentified species	-	•	•	-	•	-	•	•	•	-

[a] • = occurrence, - = absence of vegetative species; number in parenthesis () refers to numerical ranking of three most abundant vegetative species at each station

[b] See reference for arrangement and habitat of the stations.

Appendix Table A-10. Bloom species of algae detected in Tampa Bay during 1981 (adapted from HCEPC 1982).

Month	Location	Species detected
January	Hillsborough Bay	*Prorocentrum triestinum*
	Hillsborough River	*P. triestinum*
	McKay Bay	*Euglena elastica*
	Tampa Bypass Canal	*E. elastica*
	Rocky Creek	*E. elastica*
February	Upper Tampa Bay	*Gymnodinium splendens*
	Hillsborough Bay	*Prorocentrum triestinum*
March	McKay Bay	*Prorocentrum triestinum*
		Cryptomonas sp.
		Torodinium robustum
April		No blooms detected.
May	Alafia River	*Gyrodinium fissum*
June	Hillsborough Bay	*Lepocinclis playfairiana*
		Gyrodinium fissum
		Gymnodinium sp.
	Hillsborough River	*Lepocinclis playfairiana*
		Gymnodinium coeruleum
	McKay Bay	*Lepocinclis playfairiana*
	Tampa Bypass Canal	*Prorocentrum* sp.
		Gymnodinium sp.
		Euglena sp.
	Double Branch Creek	*Gymnodinium* sp.
	Channel "A"	*Gymnodinium* sp.
		Prorocentrum sp.
	Rocky Creek	*Gyrodinium* sp.
	Edgewater Creek	*Gymnodinium* sp.
	Little Manatee River	*Prorocentrum* sp.
July	Hillsborough Bay	*Lepocinclis playfairiana*
		Gymnodinium coeruleum
	Hillsborough River	*Gonyaulax diacantha*
	McKay Bay	*Lepocinclis playfairiana*
	Tampa Bypass Canal	*Gyrodinium fissum*
		Glenodinium sp.
		Prorocentrum triestinum
August	Tampa Bypass Canal	*Gymnodinium* sp.
September	Hillsborough Bay	Blue-green filamentous algae
		Euglena proxima
		Gymnodinium coeruleum
		Prorocentrum triestinum
	Tampa Bypass Canal	*Gonyaulax sp.*
		Euglena proxima

Continued.

Appendix Table A-10. Concluded.

Month	Location	Species detected
	Channel "A"	*Gonyaulax diacantha*
		Prorocentrum triestinum
October	Hillsborough Bay	Blue-green filamentous algae
		Gymnodinium sp.
	McKay Bay	*Gymnodinium* sp.
	Tampa Bypass Canal	*Gymnodinium* sp.
		Blue-green filamentous algae
	Alafia River	*Prorocentrum triestinum*
	Double Branch Creek	*Gonyaulax diacantha*
	Channel "A"	*Lepocinclis playfairiana*
	Rocky Creek	*Gonyaulax diacantha*
November	McKay Bay	*Gymnodinium* sp.
December		No blooms detected.

Appendix Table A-11. *Rare, threatened, and endangered plant species in the Tampa Bay watershed; their status and distribution among major habitats (adapted from McCoy 1980).*

Species	Source[a]						Habitat[b]													
	CITES	FCREPA	FDACS	SI	FS	FWS	Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xero-phytic oak	Cypress swamp	Swamp forest	Mangrove swamp/ coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
Acrostichum danaeifolium			T											•			•			
Adiantum tenerum			T																	
Agalinis purpurea carteri				T		1									•					
Andropogon arctatus				E		2			•											
Annona glabra			T										•		•		•			
Aristida simpliciflora			T																	
Asclepias curtissii		T	T																	
Asclepias tomentosa					R				•											
Asimina pygmaea			T						•										•	
Asplenium auritum		E	E						•											
Asplenium platyneuron			T																	
Avicennia germinans		SC																		
Azolla caroliniana			T																	
Blechnum serrulatum			T						•		•									
Bonamia grandiflora		T		T		2														
Botrychium virginianum			T																	
Cacalia floridana					U															
Calopogon barbatus	II		T						•											
Calopogon multiflorus	II		T						•						•					
Calopogon pallidus	II		T						•						•					
Calopogon tuberosus	II		T														•			
Centrosema arenicola				E		2														
Ceratiola ericoides			T																	
Ceratopteris pteridoides			T																	•

Continued.

Appendix Table A-11. Continued.

Species	Source [a]						Habitat [b]													
	CITES	FCREPA	FDACS	SI	FS	FWS	Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xero-phytic oak	Cypress swamp	Swamp forest	Mangrove swamp/ coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
Ceratopteris thalictroides			T																	•
Cereus gracilis simpsonii	II		E	E		1	•		•										•	
Cereus undatus	II		T												•					
Chamaesyce porterana porteriana				T		1			•											
Chionanthus virginicus			T									•	•		•		•			
Chrysopsis floridana		E				1			•	•										
Corallorhiza wisterana	II		T															•		
Coreopsis gladiata					U			•	•				•				•			
Cornus florida			T															•		
Dryopteris ludoviciana			T															•		
Encyclia tampensis	II		T																	•
Epidendrum conopseum	II		T																	•
Eragrostis tracyi		T	T			1													•	•
Ernodea littoralis		T					•													
Erythrodes querceticola	II		T										•							
Eulophia alta	II		T									•	•		•	•	•			
Eulophia ecristata	II		T					•	•		•				•	•				
Gordonia lasianthus			T															•		
Gossypium hirsutum		E						•	•										•	•
Gymnopogon floridanus				T		2		•	•						•	•				
Habenaria strictissima odontopetala	II		T																	•
Habenaria quinqueseta macroceratitis	II		T															•		
Habenaria quinqueseta quinqueseta	II		T																	•
Habenaria repens	II		T									•	•		•	•	•			

Continued.

Appendix Table A-11. Continued.

Species	Source[a] CITES	FCREPA	FDACS	SI	FS	FWS	Habitat[b] Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xerophytic oak	Cypress swamp	Swamp forest	Mangrove swamp/coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
Harrisella porrecta	II		T																	•
Helianthus debilis vestitus				T		2	•													
Hexalectris spicata	II		T															•		
Hypolepis repens			T															•		
Ilex ambigua			T					•			•				•			•		
Ilex cassine			T									•	•		•	•	•			
Ilex decidua			T					•			•							•		
Ilex opaca opaca			T							•										
Ilex vomitoria			T				•													
Ipomoea trichocarpa					R															•
Isoetes flaccida			T					•	•			•	•		•	•	•			
Kosteletzkya smilacifolia				T		1								•						
Lechea cernua				T		2				•										
Lechea divaricata				T		2	•			•										
Liparis elata	II		T									•	•					•		
Listera australis	II		T															•		
Lycopodium adpressum			T									•	•		•	•	•			
Lycopodium alopecuroides			T					•	•						•					
Lycopodium carolinianum			T					•	•			•	•		•	•	•			
Lycopodium cernuum			T					•	•		•	•	•		•	•	•	•		
Lycopodium prostratum			T					•				•	•		•		•			
Malaxis spicata	II		T									•	•							
Manisuris tuberculosa				T		2						•	•		•		•			
Nephrolepis biserrata			T															•		

Continued.

Appendix Table A-11. Continued.

Species	CITES	FCREPA	FDACS	SI	FS	FWS	Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xero-phytic oak	Cypress swamp	Swamp forest	Mangrove swamp/ coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
	Source [a]						Habitat [b]													
Ophioglossum nudicaule			T										•		•		•			
Ophioglossum petiolatum			T					•			•				•			•		
Opuntia humifusa	II						•	•	•											
Opuntia stricta	II		T				•											•		
Peltandra sagittifolia		R										•			•		•			
Phlebodium aureum			T															•		
Physalis viscosa elliotii				T		2	•													
Physostegia leptophylla				T		2						•	•		•		•			
Platanthera blephariglottis conspicua	II		T									•	•		•		•			
Platanthera ciliaris	II		T					•			•				•		•	•		
Platanthera cristata	II		T					•							•					
Platanthera nivea	II		T												•	•	•			
Pogonia ophioglossoides	II		T												•		•			
Polypodium dispersum			T															•		
Polypodium plumula			T																	•
Polypodium polypodioides michauxianum			T																•	
Polypodium ptilodon caespitosum			T																•	
Ponthieva racemosa racemosa	II		T									•	•		•	•	•	•		
Psilotum nudum			T									•						•		
Rhapidophyllum hystrix		T	T	T		3C												•		
Rhizophora mangle		SC												•						
Sabal etonia			T							•										
Sabal minor			T									•	•		•	•	•	•		
Sabal palmetto			T												•	•		•		

Continued.

Appendix Table A-11. Continued.

Species	Source [a] CITES	FCREPA	FDACS	SI	FS	FWS	Habitat [b] Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xerophytic oak	Cypress swamp	Swamp forest	Mangrove swamp/coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
Salvinia rotundifolia			T																	•
Scaevola plumieri			T				•													
Schizachyrium niveum				T		1		•		•	•									
Schizaea germanii		R		E		1							•							
Selaginella apoda			T															•		
Selaginella arenicola			T						•											
Sida rubromarginata				T		1		•	•											
Smilax smallii		T	T															•		
Spiranthes brevilabris brevilabris	II		T					•							•					
Spiranthes brevilabris floridana	II		T					•	•						•					
Spiranthes cernua odorata	II		T									•	•		•	•	•			•
Spiranthes cranichoides	II		T															•		
Spiranthes gracilis	II		T																	•
Spiranthes grayi	II		T																	•
Spiranthes laciniata	II		T																	•
Spiranthes lanceolata lanceolata	II		T																	•
Spiranthes lanceolata paludicola	II		T	E		1							•							
Spiranthes longilabris	II		T					•	•						•	•				
Spiranthes polyantha	II		T	T		2		•	•		•									•
Spiranthes praecox	II		T																	•
Spiranthes vernalis	II		T																	•
Thelypteris augescens			T													•		•		
Thelypteris dentata			T																	•
Thelypteris interrupta			T					•			•	•			•		•	•		

Continued.

Appendix Table A-11. Concluded.

Species	Source[a]						Habitat[b]													
	CITES	FCREPA	FDACS	SI	FS	FWS	Coastal strand	Pine flatwoods	Southern slash pine forest	Sand pine scrub	Longleaf pine/xerophytic oak	Cypress swamp	Swamp forest	Mangrove swamp/coastal marsh	Prairie grassland	Open-scrub cypress	Freshwater marsh	Hammock	Shell mound	Other
Thelypteris kunthii			T									•						•		
Thelypteris ovata			T															•		
Thelypteris palustris			T												•			•		
Thelypteris quadrangularis versicolor			T																	•
Tillandsia fasciculata			E									•						•		
Tillandsia setacea			T										•					•		
Tillandsia simulata			T															•		
Tillandsia utriculata			T															•		
Triphora latifolia	II		T	E		2												•		
Triphora ricketii	II		T															•		
Triphora trianthophora	II		T															•		
Verbena tampensis				E		1												•		•
Vittaria lineata			T							•								•		
Woodwardia areolata			T									•	•		•	•	•			
Woodwardia virginica			T					•	•			•	•		•	•	•			
Zamia pumila	II	T	T	E		3C		•	•		•				•	•		•		
Zephyranthes atamasco			E												•					•
Zephyranthes simpsonii			T	T		3C		•	•											
Zephyranthes treatiae			T	T		3C						•			•					

[a] Citations = Convention on International Trade in Endangered Species of Wild Flora and Fauna (1976); FCREPA = Florida Committee on Rare and Endangered Plants and Animals (Ward 1979); FDACS = Florida Department of Agriculture and Consumer Services (Florida Statutes 1979); SI = Smithsonion Institution (Ayensu and Defilipps 1978); FS = Forest Service (Duncan 1970); FWS= U.S. Fish and Wildlife Service (Federal Register 1980); 11 = appendix 11 of cites list; E = endangered; T = threatened; R = rare; U = uncommon; SC = special concern; 1,2,3 = FWS categories in 1980 Federal Register where (1) taxa has sufficient information to support listing, (2) further research is necessary to support listing, and (3) taxa no longer is considered for listing because (a) evidence of extinction, (b) species no longer valid or, (c) more widespread or abundant than previously thought.

[b] Habitat categories used by McCoy (1980) are those of Davis (1967) and do not entirely correspond to those described in the text.

Appendix Table A-12. Habitat distribution and relative abundance of freshwater fish in the Tampa Bay watershed (adapted from Layne et al. 1977).

	Habitat Type[a]								
Common Name (Species Name)	**Springs**	**Lakes**	**Ponds**	**Artificial Impoundments**	**Rivers**	**Streams**	**Ditches-Canals**	**Marshes-Sloughs**	**Swamps**
Acipenseridae (Peripheral)									
Atlantic sturgeon (*Acipenser oxyrhynchus*)	-	-	-	-	S	-	-	-	-
Lepisosteidae (Primary)									
Longnose gar (*Lepisosteus osseus*)	-	U	U	S	C	-	-	-	-
Florida gar (*L. platyrhincus*)	-	A	A	C	A	C	C	C	C
Amiidae (Primary)									
Bowfin (*Amia calva*)	-	C	C	C	C	C	U	U	-
Elopidae (Peripheral)									
Tarpon (*Megalops atlanticus*)	-	-	-	-	R	R	R	-	-
Esocidae (Primary)									
Redfin pickerel (*Esox americanus americanus*)	-	-	C	-	U	S	-	R	S
Chain pickerel (*E. niger*)	-	C	-	-	C	S	-	-	-
Cyprinidae (Primary)									
Grass carp (*Ctenopharyngodon idella*)	-	C			(see text)				
Redeye chub (*Notropis harperi*)	C	-	-	-	-	-	S	-	-
Golden shiner (*Notemigonus crysoleucas*)	-	C	C	C	C	C	S	C	-
Ironcolor shiner (*Notropis chalybaeus*)	-	-	-	-	U	-	-	-	-
Dusky shiner (*N. cummingsae*)	-	-	-	-	V	-	-	-	-
Pugnose minnow (*Notropis emiliae*)	-	-	-	-	R	R	-	-	-
Sailfin shiner (*N. hypselopterus*)	-	-	-	-	C	-	V	-	-
Coastal shiner (*N. petersoni*)	-	R	-	-	A	A	-	-	-
Taillight shiner (*N. maculatus*)	-	C	-	U	C	U	U	V	-
Catostomidae (Primary)									
Lake chubsucker (*Erimyzon sucetta*)	-	A	A	C	U	U	U	U	U
Ictaluridae (Primary)									
White Catfish (*Ictalurus catus*)	-	U	-	U	C	S	S	V	-
Yellow bullhead (*I. natalis*)	-	C	C	U	C	C	C	U	-
Brown bullhead (*I. nebulosus*)	-	A	A	C	C	C	C	C	-
Channel Catfish (*I. punctatus*)	-	U	-	U	C	S	-	V	-
Tadpole madtom (*Noturus gyrinus*)	-	C	-	U	C	S	R	U	-

Continued.

Appendix Table A-12. Continued.

Common Name (Species Name)	Habitat Type[a]								
	Springs	Lakes	Ponds	Artificial Impoundments	Rivers	Streams	Ditches-Canals	Marshes-Sloughs	Swamps
Percichthyidae (Peripheral)									
Striped bass (*Morone saxatilis*)	-	C	-	C	-	-	-	-	-
Centrarchidae (Primary)									
Everglades pygmy sunfish (*Elassoma evergladei*)	-	-	S	-	U	U	-	S	C
Okefenokee pygmy sunfish (*E. okefenokee*)	-	-	-	-	S	-	-	-	-
Bluespotted sunfish (*Enneacanthus gloriosus*)	-	C	C	U	U	U	S	U	S
Redbreast sunfish (*Lepomis auritus*)	-	U	U	-	C	U	-	-	-
Warmouth (*L. gulosus*)	-	C	C	C	C	C	C	C	-
Bluegill (*L. macrochirus*)	C	A	A	A	C	A	C	C	S
Dollar sunfish (*L. marginatus*)	-	C	C	-	C	U	U	-	-
Redear sunfish (*L. microlophus*)	-	C	U	C	C	U	-	R	-
Spotted sunfish (*L. punctatus*)	-	R	-	U	A	C	S	S	-
Largemouth bass (*Micropterus salmoides*)	-	C	C	C	C	C	C	U	U
Black crappie (*Pomoxis nigromaculatus*)	-	A	C	-	C	R	-	S	V
Percidae (Primary)									
Swamp darter (*Etheostoma fusiforme*)	-	C	U	U	U	U	S	R	-
Aphredoderidae (Primary)									
Pirate perch (*Aphredoderus sayanus*)	-	-	S	-	U	S	S	S	-
Cyprinodontidae (Secondary)									
Sheepshead minnow (*Cyprinodon variegatus*)	-	-	-	-	U	U	-	-	-
Goldspotted killifish (*Floridichthys carpio*)	-	-	-	-	-	S	-	-	-
Golden topminnow (*Fundulus chrysotus*)	-	C	A	-	C	C	C	R	C
Banded topminnow (*F. cingulatus*)	-	S	S	-	S	S	-	-	-
Marsh killifish (*F. confluentus*)	-	-	-	-	-	V	R	-	S
Seminole killifish (*F. seminolis*)	-	C	S	U	C	S	R	-	-
Starhead topminnow (*F. notti* [=*lineolatus*])	-	R	R	-	R	-	V	-	-
Flagfish (*Jordanella floridae*)	-	U	U	-	U	U	U	U	U
Pygmy killifish (*Leptolucania ommata*)	-	-	-	-	S	-	-	-	-
Bluefin killifish (*Lucania goodei*)	S	C	C	-	C	C	C	U	U
Rainwater killifish (*L. parva*)	-	-	-	-	S	-	S	-	-
Diamond killifish (*Adinia xenica*)	-	-	-	-	S	-	C	-	-

Continued.

Appendix Table A-12. Concluded.

Common Name (Species Name)	Springs	Lakes	Ponds	Artificial Impoundments	Rivers	Streams	Ditches-Canals	Marshes-Sloughs	Swamps
	Habitat Type[a]								
Poeciliidae (Secondary)									
Mosquito fish (*Gambusia affinis*)	-	A	A	C	A	A	A	C	C
Least killifish (*Heterandria formosa*)	-	C	A	-	A	A	A	C	C
Sailfin molly (*Poecilia latipinna*)	S	C	C	U	C	U	C	U	U
Black molly (*P. latipinna x velifera*)		Established but habitat unknown							
Swordtail molly (*P. petenensis*)		Established but habitat unknown							
Guppy (*P. reticulata*)		Established but habitat unknown							
Liberty molly (*P. sphenops*)		Established but habitat unknown							
Clariidae (Secondary)									
Walking Catfish (*Clarias batrachus*)	-	-	-	-	S	-	S	-	-
Cichlidae (Secondary)									
Blue acara (*Aequidens pulcher*)									
Jack Dempsey (*Cichlasoma octofasciatum*)	-	-	-	-	-	S	S	-	-
Rio Grande cichlid (*C. cyanoguttatum*)	-	-	S	S	-	S	-	-	-
Jewelfish (*Hemichromis bimaculatus*)	S	-	-	-	-	-	-	-	-
Blue tilapia (*Tilapia aurea*)	S	A	A	C	S	-	-	-	-
Blackchin tilapia (*T. melanotheron*)	S	-	-	-	C	S	-	-	-
Mozambique tilapia (*T. mossambica*)	-	-	-	-	-	S	-	-	-
Congo tilapia (*T. sparmanni*)	-	S	-	-	-	-	-	-	-
Atherinidae (Peripheral)									
Brook silverside (*Labidesthes sicculus*)	S	C	U	U	C	C	U	S	-
Inland silverside (*Menidia beryllina*)	-	U	-	-	U	-	-	R	-
Clupeidae (Peripheral)									
Gizzard Shad (*Dorosoma cepedianum*)	-	A	R	A	U	R	-	R	-
Threadfin Shad (*D. petenense*)	-	A	R	C	R	-	-	-	-
Belonidae (Peripheral)									
Atlantic needlefish (*Strongylura marina*)	-	U	-	-	R	-	-	-	-
Anguillidae (Peripheral)									
American eel (*Anguilla rostrata*)	-	C	-	U	C	U	U	U	-

[a] Relative abundance categories and abbreviations: abundant (A), common (C), uncommon (U), rare (R), very rare (V), population status questionable (S).

Appendix Table A-13. Composite list of fish species reported from Tampa Bay (adapted from Comp 1984).

Species	Habitat Type[a]
Class Chondrichthyes	
Family Orectolobidae	
Nurse shark (*Ginglymostoma cirratum*)	M
Family Rhincodontidae	
Whale shark (*Rhincodon typus*)	M*
Family Odontaspididae	
Sand tiger (*Odontaspis taurus*)	M*
Family Lamnidae	
White shark (*Carcharodon carcharias*)	M*
Family Carcharhinidae	
Blacknose shark (*Carcharhinus acronotus*)	M
Bull shark (*C. leucas*)	M
Blacktip shark (*C. limbatus*)	M,E
Dusky shark (*C. obscurus*)	M
Sandbar shark (*C. plumbeus*)	M*
Lemon shark (*Negaprion brevirostris*)	M*
Family Sphyrnidae	
Great hammerhead (*Sphyrna mokarran*)	M*
Bonnethead (*S. tiburo*)	M,E
Order Rajiformes	
Family Pristidae	
Smalltooth sawfish (*Pristis pectinata*)	M,E*
Family Rhinobatidae	
Atlantic guitarfish (*Rhinobatos lentiginosus*)	M
Family Dasyatidae	
Southern stingray (*Dasyatis americana*)	M,E
Atlantic stingray (*D. sabina*)	M,E*
Bluntnose stingray (*D. sayi*)	M,E
Smooth butterfly ray (*Gymnura micrura*)	M,E
Family Myliobatidae	
Spotted eagle ray (*Aetobatus narinari*)	M
Cownose ray (*Rhinoptera bonasus*)	M,E
Family Mobulidae	
Atlantic manta (*Manta birostris*)	M
Class Osteichthyes	
Order Acipenseriformes	
Family Acipenseridae	
Atlantic sturgeon (*Acipenser oxyrhynchus*)	E*
Order Semionotiformes	
Family Lepisosteidae	
Longnose gar (*Lepisosteus osseus*)	F*
Florida gar (*L. platyrhincus*)	F*
Order Elopiformes	
Family Elopidae	
Ladyfish (*Elops saurus*)	M,E
Tarpon (*Megalops atlanticus*)	M,E
Family Albulidae	
Bonefish (*Albula vulpes*)	M
Order Anguilliformes	
Family Anguillidae	
American eel (*Anguilla rostrata*)	M,E*
Family Muraenidae	
Ocellated moray (*Gymnothorax saxicola*)	M*
Family Ophichthidae	
Sooty eel (*Bascanichthys bascanium*)	M*
Spotted spoon-nose eel (*Echiophis intertinctus*)	M*
Stippled spoon-nose eel (*E. punctifer*)	M*
Speckled worm eel (*Myrophis punctatus*)	M,E
Shrimp eel (*Ophichthus gomesi*)	M,E
Palespotted eel (*O. ocellatus*)	M*
Order Clupeiformes	
Family Clupeidae	
Gulf menhaden (*Brevoortia patronus*)	M,E
Yellowfin menhaden (*B. smithi*)	M
Gizzard shad (*Dorosoma cepedianum*)	F*
Threadfin shad (*D. petenense*)	F*
Scaled sardine (*Harengula jaguana*)	M,E
Atlantic thread herring (*Opisthonema oglinum*)	M,E
Spanish sardine (*Sardinella aurita*)	M
Family Engraulidae	
Cuban anchovy (*Anchoa cubana*)	M
Striped anchovy (*A. hepsetus*)	M,E
Bay anchovy (*A. mitchilli*)	M,E
Order Myctophiformes	
Family Synodontidae	
Inshore lizardfish, galliwasp (*Synodus foetens*)	M,E

Continued.

Appendix Table A-13. Continued.

Species	Habitat Type[a]
Order Siluriformes	
Family Ariidae	
Hardhead catfish (*Arius felis*)	M,E
Gafftopsail catfish (*Bagre marinus*)	M,E
Family Ictaluridae	
Brown bullhead (*Ictalurus nebulosus*)	F*
Order Batrachoidiformes	
Family Batrachoididae	
Gulf toadfish (*Opsanus beta*)	M,E
Leopard toadfish (*O. pardus*)	M
Atlantic midshipman (*Porichthys plectrodon*)	M,E
Order Gobiesociformes	
Family Gobiesocidae	
Skilletfish (*Gobiesox strumosus*)	M,E
Order Lophiiformes	
Family Ogcocephalidae	
Pancake batfish (*Halieutichthys aculeatus*)	M*
Polka-dot batfish (*Ogcocephalus radiatus,*)	M,E
Order Gadiformes	
Family Gadidae	
Southern hake (*Urophycis floridana*)	M,E
Family Ophidiidae	
Longnose cusk-eel (*Ophidion beani*)	M*
Blotched cusk-eel (*O. grayi*)	M
Crested cusk-eel (*O. welshi*)	M
Order Atheriniformes	
Family Exocoetidae	
Ballyhoo (*Hemiramphus brasiliensis*)	M*
Halfbeak (*Hyporhamphus unifasciatus*)	M,E
Family Belonidae	
Atlantic needlefish (*Strongylura marina*)	M*
Redfin needlefish (*S. notata*)	M,E
Timucu (*S. timucu*)	M,E
Houndfish (*Tylosurus crocodilus*)	M*
Family Cyprinodontidae	
Diamond killifish (*Adinia xenica*)	E
Sheepshead minnow (*Cyprinodon variegatus*)	E
Goldspotted killifish (*Floridichthys carpio*)	E
Family Cyprinodontidae (continued)	
Marsh killifish (*Fundulus confluentus*)	E
Gulf killifish (*F. grandis*)	E
Seminole killifish (*F. seminolis*)	F*
Longnose killifish (*F. similis*)	E
Rainwater killifish (*Lucania parva*)	E
Family Poeciliidae	
Mosquitofish (*Gambusia affinis*)	F,E
Sailfin molly (*Poecilia latipinna*)	E
Family Atherinidae	
Rough silverside (*Membras martinica*)	E
Tidewater silverside (*Menidia peninsulae*)	E
Order Lampridiformes	
Family Regalecidae	
Oarfish (*Regalecus glesne*)	M*
Order Gasterosteiformes	
Family Syngnathidae	
Lined seahorse (*Hippocampus erectus*)	E
Dwarf seahorse (*H. zosterae*)	E
Fringed pipefish (*Micrognathus criniger*)	E
Dusky pipefish (*Syngnathus floridae*)	E
Chain pipefish (*S. louisianae*)	E
Gulf pipefish (*S. scovelli*)	E
Order Perciformes	
Family Centrarchidae	
Bluegill (*Lepomis macrochirus*)	F*
Largemouth bass (*Micropterus salmoides*)	F*
Family Centropomidae	
Snook (*Centropomus undecimalis*)	M,E
Family Cichlidae	
Blackchin tilapia (*Tilapia melanotheron*)	E
Family Serranidae	
Black sea bass (*Centropristis striata*)	M*
Sand perch (*Diplectrum formosum*)	M
Jewfish (*Epinephelus itajara*)	M,E
Red grouper (*E. morio*)	M*
Gag (*Mycteroperca microlepis*)	M
Belted sandfish (*Serranus subligarius*)	M*

Continued.

Appendix Table A-13. Continued.

Species	Habitat Type[a]
Family Grammistidae	
Greater soapfish *(Rypticus saponaceus)*	M*
Family Apogonidae	
Bronze cardinalfish *(Astrapogon alutus)*	M*
Family Pomatomidae	
Bluefish *(Pomatomus saltatrix)*	M,E
Family Rachycentridae	
Cobia *(Rachycentron canadum)*	M,E
Family Echeneidae	
Sharksucker *(Echeneis naucrates)*	M,E
Remora *(Remora remora)*	M,E
Family Carangidae	
Blue runner *(Caranx crysos)*	M
Crevalle jack *(C. hippos)*	M,E
Horse-eye jack *(C. latus)*	E*
Atlantic bumper *(Chloroscombrus chrysurus)*	M,E
Bluntnose jack *(Hemicaranx amblyrhyncus)*	M*
Leatherjacket *(Oligoplites saurus)*	M,E
Atlantic moonfish *(Selene setapinnis)*	M*
Lookdown *(Selene vomer)*	M
Florida pompano *(Trachinotus carolinus)*	M,E
Permit *(T. falcatus)*	M,E
Palometa *(T. goodei)*	M
Family Lutjanidae	
Schoolmaster *(Lutjanus apodus)*	M*
Gray snapper *(L. griseus)*	M,E
Lane snapper *(L. synagris)*	M,E
Family Lobotidae	
Tripletail *(Lobotes surinamensis)*	M,E
Family Gerreidae	
Irish pompano *(Diapterus auratus)*	M*
Striped mojarra *(D. plumieri)*	E
Spotfin mojarra *(Eucinostomus argenteus)*	M,E
Silver jenny *(E. gula)*	M,E
Yellowfin mojarra *(Gerres cinereus)*	E*
Family Pomadasyidae	
Tomtate *(Haemulon aurolineatum)*	M*
White grunt *(H. plumieri)*	M
Pigfish *(Orthopristis chrysoptera)*	M,E
Family Sparidae	
Sheepshead *(Archosargus probatocephalus)*	M,E
Grass porgy *(Calamus arctifrons)*	M*
Family Sparidae (continued)	
Spottail pinfish *(Diplodus holbrooki)*	M
Pinfish *(Lagodon rhomboides)*	M,E
Family Sciaenidae	
Silver perch *(Bairdiella chrysoura)*	M,E
Sand seatrout *(Cynoscion arenarius)*	M,E
Spotted seatrout *(C. nebulosus)*	M,E
High-hat *(Equetus acuminatus)*	M,*
Cubbyu *(E. umbrosus)*	M*
Spot *(Leiostomus xanthurus)*	M,E
Southern kingfish *(Menticirrhus americanus)*	M,E
Gulf kingfish *(M. littoralis)*	M
Northern kingfish *(M. saxatilis)*	M,E
Atlantic croaker *(Micropogonias undulatus)*	E
Black drum *(Pogonias cromis)*	M,E
Red drum *(Sciaenops ocellatus)*	M,E
Family Mullidae	
Spotted goatfish *(Pseudupeneus maculatus)*	M*
Family Kyphosidae	
Bermuda chub *(Kyphosus sectatrix)*	M*
Family Ephippidae	
Atlantic spadefish *(Chaetodipterus faber)*	M,E
Family Labridae	
Slippery dick *(Halichoeres bivittatus)*	M*
Hogfish *(Lachnolaimus maximus)*	M*
Family Scaridae	
Emerald parrotfish *(Nicholsina usta)*	M
Family Mugilidae	
Striped mullet *(Mugil cephalus)*	M,E
White mullet *(M. curema)*	M,E
Fantail mullet *(M. trichodon)*	M,E
Family Sphyraenidae	
Great barracuda *(Sphyraena barracuda)*	M,E
Northern sennet *(S. borealis)*	M*
Guaguanche *(S. guachancho)*	M*

Continued.

Appendix Table A-13. Concluded.

Species	Habitat Type[a]
Family Polynemidae	
Atlantic threadfin *(Polydactylus octonemus)*	M*
Family Opistognathidae	
Moustache jawfish *(Opistognathus lonchurus)*	M*
Family Dactyloscopidae	
Sand stargazer *(Dactyloscopus tridigitatus)*	M*
Family Uranoscopidae	
Southern stargazer *(Astroscopus y-graecum)*	M,E
Family Clinidae	
Banded blenny *(Paraclinus fasciatus)*	E*
Marbled blenny *(P. marmoratus)*	E*
Striped blenny *(Chasmodes bosquianus)*	M*
Florida blenny *(C. saburrae)*	M,E
Crested blenny *(Hypleurochilus geminatus)*	M*
Feather blenny *(Hypsoblennius hentzi)*	M,E
Highfin blenny *(Lupinoblennius nicholsi)*	M*
Seaweed blenny *(Blennius marmoreus)*	M*
Family Eleotridae	
Fat sleeper *(Dormitator maculatus)*	F*
Family Gobiidae	
Frillfin goby *(Bathygobius soporator)*	E
Darter goby *(Gobionellus boleosoma)*	E
Sharptail goby *(G. hastatus)*	E
Naked goby *(Gobiosoma bosci)*	E
Twoscale goby *(G. longipala)*	E*
Tiger goby *(G. macrodon)*	M,E
Code goby *(G. robustum)*	E
Clown goby *(Microgobius gulosus)*	E
Green goby *(M. thalassinus)*	E
Family Trichiuridae	
Atlantic cutlassfish *(Trichiurus lepturus)*	M
Family Scombridae	
King mackerel *(Scomberomorus cavalla)*	M
Spanish mackerel *(S. maculatus)*	M,E
Family Stromateidae	
Harvestfish *(Peprilus alepidotus)*	M*
Butterfish *(P. triacanthus)*	M*
Family Scorpaenidae	
Barbfish *(Scorpaena brasiliensis)*	M*
Family Triglidae	
Horned searobin *(Bellator militaris)*	M*
Bluespotted searobin *(Prionotus roseus)*	M*
Blackfin searobin *(P. rubio)*	M*
Leopard searobin *(P. scitulus)*	M,E
Bighead searobin *(P. tribulus)*	M,E
Order Pleuronectiformes	
Family Bothidae	
Ocellated flounder *(Ancylopsetta quadrocellata)*	M*
Spotted whiff *(Citharichthys macrops)*	M*
Fringed flounder *(Etropus crossotus)*	M
Gulf flounder *(Paralichthys albigutta)*	M,E
Dusky flounder *(Syacium papillosum)*	M*
Family Soleidae	
Lined sole *(Achirus lineatus)*	M,E
Hogchoker *(Trinectes maculatus)*	M,E
Family Cynoglossidae	
Blackcheek tonguefish *(Symphurus plagiusa)*	M,E
Order Tetraodontiformes	
Family Balistidae	
Orange filefish *(Aluterus schoepfi)*	M
Fringed filefish *(Monacanthus ciliatus)*	M,E
Planehead filefish *(M. hispidus)*	M,E
Family Ostraciidae	
Scrawled cowfish *(Lactophrys quadricornis)*	M,E
Trunkfish *(L. trigonus)*	M,E*
Smooth trunkfish *(L. triqueter)*	M*
Family Tetraodontidae	
Smooth puffer *(Lagocephalus laevigatus)*	M,E*
Southern puffer *(Sphoeroides nephelus)*	M,E
Family Diodontidae	
Striped burrfish *(Chilomycterus schoepfi)*	M,E
Balloonfish *(Diodon holocanthus)*	M*

[a] M = marine, E = estuarine, F = freshwater, * = uncommon to rare

Appendix Table A-14. Habitat distribution and relative abundance of terrestrial reptiles in the Tampa Bay watershed (adapted from Layne et al. 1977).

Common Name (Species Name)	Pine-turkey oak	Sand pine scrub	Scrubby flatwoods	Typical flatwoods	Cabbage palm hammocks	Live oak hammocks	Mesic Hammocks	Groves/parklands/etc.	Bay forest	Dry brushland	Dry prairie	Pasture/cropland/etc.	Artificial barrenland	Urban
	Habitat Type[a]													
Box turtle (*Terrapene carolina*)	R	-	-	C	-	U	U	U	-	-	U	R	-	-
Chicken turtle (*Deirochelys reticularia*)	-	-	-	-	-	-	-	-	R	-	-	-	-	-
Gopher tortoise (*Gopherus polyphemus*)	C	C	C	U	-	U	-	U	-	-	-	-	-	-
Mediterranean gecko (*Hemidactylus turcicus*)	-	-	-	-	-	-	-	R	-	-	-	-	-	R
Gekko (*Gekko gekko*)	-	-	-	-	-	-	-	-	-	-	-	-	-	R
Green anole (*Anolis carolinensis*)	A	C	U	U	U	C	C	C	-	-	-	U	-	-
Brown anole (*Anolis sagrei*)	-	-	-	-	-	-	-	U	-	-	-	-	-	U
Eastern fence lizard (*Sceloporus undulatus*)	C	-	-	U	-	U	-	-	-	-	-	-	-	-
Florida scrub lizard (*Sceloporus woodi*)	R	C	R	-	-	-	-	-	-	-	-	-	-	-
Texas horned lizard (*Phrynosoma cornutum*)	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Six-lined racerunner (*Cnemidophorus sexlineatus*)	C	C	C	U	-	-	-	C	-	-	-	U	U	-
Ground skink (*Scincella lateralis*)	U	-	U	R	U	C	-	C	U	-	-	C	-	-
Broad-headed skink (*Eumeces laticeps*)	-	-	-	-	-	U	S	-	-	-	-	-	-	-
Southeastern five-lined skink (*Eumeces inexpectatus*)	C	C	U	U	U	U	R	U	U	-	-	R	-	-
Mole skink (*Eumeces egregius*)	R	R	-	-	-	R	-	-	-	-	-	-	-	-
Blue-tailed mole skink (*Eumeces egregius lividus*)	R	R	-	-	-	-	-	-	-	-	-	-	-	-
Florida sand skink (*Neoseps reynoldsi*)	R	U	-	-	-	V	-	-	-	-	-	-	-	-
Eastern glass lizard (*Ophisaurus ventralis*)	R	-	R	U	-	U	U	U	-	-	R	R	-	-
Slender glass lizard (*Ophisaurus attenuatus*)	R	-	-	R	-	R	-	R	-	R	U	U	-	-
Island glass lizard (*Ophisaurus compressus*)	R	U	U	R	-	-	-	-	-	-	-	-	-	-
Florida worm lizard (*Rhineura floridana*)	U	U	U	R	-	U	-	U	-	-	-	U	-	-
DeKay's brown snake (*Storeria dekayi*)	R	-	-	R	-	-	-	-	-	-	-	-	-	-
Red-bellied snake (*Storeria occipitomaculata*)	-	-	-	-	-	R	R	-	-	-	-	-	-	-
Common garter snake (*Thamnophis sirtalis*)	R	-	-	R	-	U	U	C	U	-	-	-	-	-
Eastern ribbon snake (*Thamnophis sauritus*)	-	-	-	U	C	-	U	C	C	-	-	-	-	-
Eastern hognose snake (*Heterodon platyrhinos*)	U	-	R	U	-	U	-	U	-	-	-	-	-	-
Southern hognose snake (*Heterodon simus*)	R	-	-	R	-	-	-	-	-	-	R	-	-	S
Ringneck snake (*Diadophis punctatus*)	U	-	-	U	U	U	U	C	-	-	-	-	-	-
Pine woods snake (*Rhadinaea flavilata*)	R	-	-	U	R	-	-	-	-	-	-	-	-	-

Continued.

Appendix Table A-14. Concluded).

Common Name (Species Name)	Pine-turkey oak	Sand pine scrub	Scrubby flatwoods	Typical flatwoods	Cabbage palm hammocks	Live oak hammocks	Mesic Hammocks	Groves/parklands/etc.	Bay forest	Dry brushland	Dry prairie	Pasture/cropland/etc.	Artificial barrenland	Urban
	Habitat Type[a]													
Mud snake (*Farancia abacura*)	-	-	-	-	-	-	-	-	C	-	-	-	-	-
Racer (*Coluber constrictor*)	C	C	C	C	U	A	U	C	-	C	C	A	-	-
Coachwhip (*Masticophis flagellum*)	U	U	U	U	-	U	R	U	-	-	R	R	-	-
Rough green snake (*Opheodrys aestivus*)	U	U	U	U	-	U	U	R	U	-	-	-	-	-
Eastern indigo snake (*Drymarchon corais couperi*)	U	-	-	U	R	U	R	R	R	R	R	-	-	-
Corn snake (*Elaphe guttata*)	U	U	U	U	U	U	U	U	-	-	-	U	-	-
Rat snake (*Elaphe obsoleta*)	U	U	U	U	C	U	C	C	U	-	-	U	-	-
Pine snake (*Pituophis melanoleucus*)	U	U	-	R	-	R	-	U	-	-	-	-	-	-
Kingsnake (*Lampropeltis getulus*)	U	U	-	U	U	U	U	-	C	-	-	-	-	-
Milksnake (*Lampropeltis triangulum*)	U	-	-	R	-	U	R	R	-	-	-	-	-	-
Scarlet snake (*Cemophora coccinea*)	R	-	-	R	R	R	R	-	-	-	-	-	-	-
Short-tailed snake (*Stilosoma extenuatum*)	V	V	-	-	-	-	-	-	-	-	-	-	-	-
Florida crowned snake (*Tantilla relicta*)	R	R	-	V	R	-	-	-	-	-	-	-	-	-
Eastern coral snake (*Micrurus fulvius fulvius*)	U	-	-	R	U	U	U	R	-	-	-	-	-	-
Cottonmouth (*Agkistrodon piscivorus*)	-	-	-	R	-	U	U	-	-	-	-	U	-	-
Pigmy rattlesnake (*Sistrurus miliarius*)	U	-	R	U	-	U	-	-	-	-	-	R	-	-
Eastern diamondback rattlesnake (*Crotalus adamanteus*)	U	U	C	C	U	U	U	U	-	C	C	U	-	-

[a] Relative abundance categories and abbreviations: Abundant (A), Common (C), Uncommon (U), Rare (R), Very rare (V), Breeding population (B), Population status questionable (S)

Appendix Table A-15. Wetland and aquatic habitat distribution and relative abundance of reptiles in the Tampa Bay watershed (adapted from Layne et al. 1977).

Species	Hardwood swamp	Cypress swamp	Mangrove swamp	Artificial swamp	Swamp thicket	Wet prairie	Freshwater marsh	Artificial marsh	Saltwater marsh	Dunes/beaches/flats	Lakes/ponds	Rivers/streams	Springs	Artificial fresh waters	Coastal/bays/estuaries	Offshore
	Habitat Type [a]															
Reptiles																
American alligator *(Alligator mississippiensis)*	C	U	U	–	–	–	C	C	U	–	C	C	C	C	–	–
Green anole *(Anolis carolinensis)*	A	A	–	–	A	–	U	U	S	–	–	–	–	–	–	–
Brown anole *(Anolis sagrei)*	U	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Six–lined racerunner *(Cnemidophorus sexlineatus)*	–	–	–	–	–	–	–	–	–	U	–	–	–	–	–	–
Ground skink *(Scincella lateralis)*	C	U	–	–	U	–	–	–	–	–	–	–	–	–	–	–
Southeastern five–lined skink *(Eumeces inexpectatus)*	C	C	U	–	U	–	–	–	–	U	–	–	–	–	–	–
Eastern glass lizard *(Ophisaurus ventralis)*	U	R	–	–	–	U	–	–	–	R	–	–	–	–	–	–
Island glass lizard *(Ophisaurus compressus)*	–	–	–	–	–	–	–	–	–	U	–	–	–	–	–	–
Snakes																
Green water snake *(Nerodia cyclopion)*	U	U	–	–	–	R	C	R	–	–	C	U	C	C	–	–
Brown water snake *(Nerodia taxispilota)*	R	U	–	–	–	–	–	–	–	–	U	C	C	U	–	–
Banded water snake *(Nerodia fasciata)*	R	U	U	–	U	–	A	A	U	–	A	A	S	A	S	–
Striped crayfish snake *(Regina alleni)*	U	U	–	–	R	C	C	R	–	–	C	U	U	U	–	–
Black swamp snake *(Seminatrix pygaea)*	U	R	–	–	–	U	U	–	–	–	U	R	–	U	–	–
Brown snake *(Storeria dekayi)*	R	R	–	–	–	R	R	R	–	–	R	–	–	R	–	–
Garter snake *(Thamnophis sirtalis)*	U	U	–	–	U	C	C	C	C	R	U	U	–	C	–	–
Eastern ribbon snake *(Thamnophis sauritus)*	U	U	–	–	C	A	A	A	R	R	C	C	C	A	–	–
Ringneck snake *(Diadophis punctatus)*	–	–	–	–	–	C	C	C	R	–	–	R	–	U	–	–
Pine woods snake *(Rhadinaea flavilata)*	V	V	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mud snake *(Farancia abacura)*	R	U	–	–	C	C	C	C	–	–	U	R	–	C	–	–
Racer *(Coluber constrictor)*	C	U	–	–	–	U	U	U	R	–	–	–	–	–	–	–
Rough green snake *(Opheodrys aestivus)*	R	R	R	–	U	–	–	–	–	–	R	–	–	R	–	–
Eastern indigo snake *(Drymarchon corais couperi)*	R	R	V	–	–	–	–	–	–	–	–	–	–	–	–	–
Corn snake *(Elaphe guttata)*	R	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rat snake *(Elaphe obsoleta)*	U	U	–	–	U	R	R	–	R	–	R	–	–	R	–	–

Continued.

Appendix Table A-15. Concluded.

Species	Hardwood swamp	Cypress swamp	Mangrove swamp	Artificial swamp	Swamp thicket	Wet prairie	Freshwater marsh	Artificial marsh	Saltwater marsh	Dunes/beaches/flats	Lakes/ponds	Rivers/streams	Springs	Artificial fresh waters	Coastal/bays/estuaries	Offshore
	Habitat Type [a]															
Common kingsnake *(Lampropeltis getulus)*	U	U	–	–	C	C	C	–	U	–	R	R	–	U	–	–
Milksnake *(Lampropeltis triangulum)*	U	R	–	–	–	–	–	–	–	–	R	–	–	R	–	–
Eastern coral snake *(Micrurus fulvius)*	R	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cottonmouth *(Agkistrodon piscivorus)*	U	C	–	–	U	C	C	U	–	–	C	U	–	C	–	–
Pigmy rattlesnake *(Sistrurus miliarius)*	R	U	–	–	U	U	U	U	–	–	U	–	–	–	–	–
Eastern diamondback rattlesnake *(Crotalus adamanteus)*	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–
Turtles																
Snapping turtle *(Chelydra serpentina)*	–	U	–	–	–	U	C	C	R	–	C	U	C	U	–	–
Stinkpot *(Sternotherus odoratus)*	R	R	–	R	–	C	C	C	–	–	C	C	C	C	–	–
Mud turtle *(Kinosternon subrubrum)*	–	R	–	–	U	U	U	U	–	–	U	R	U	U	–	–
Striped mud turtle *(Kinosternon bauri)*	C	U	U	C	U	U	U	U	R	–	C	U	–	C	–	–
Box turtle *(Terrapene carolina)*	U	R	R	–	–	U	–	–	R	R	–	–	–	R	–	–
Diamondback terrapin *(Malaclemys terrapin)*	–	–	C	–	–	–	–	–	C	–	–	V	–	–	C	–
Suwannee cooter *(Pseudemys concinna suwanniensis)*	–	–	–	–	–	–	–	–	–	–	–	R	C	–	–	–
Cooter *(Pseudemys floridana)*	U	U	–	U	–	–	C	C	U	–	A	C	C	C	–	–
Florida red-bellied turtle *(Chrysemys nelsoni)*	–	U	U	–	–	C	C	U	U	–	U	U	R	A	–	–
Chicken turtle *(Deirochelys reticularia)*	–	R	U	–	–	C	C	C	–	–	C	C	U	C	–	–
Gopher tortoise *(Gopherus polyphemus)*	–	–	–	–	–	–	–	–	–	C	–	–	–	–	–	–
Atlantic green turtle *(Chelonia mydas mydas)*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V	–
Atlantic loggerhead *(Caretta caretta caretta)*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V	–
Kemp's ridley *(Lepidochelys kempi)*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V	–
Atlantic leatherback *(Dermochelys coriacea coriacea)*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V
Florida softshell turtle *(Trionyx ferox)*	–	R	R	–	–	–	C	C	–	–	C	C	S	C	–	–

[a] Relative abundance categories and abbreviations: Abundant (A), Common (C), Uncommon (U), Rare (R), Very rare (V), Population status questionable (S)

Appendix Table A-16. Terrestrial habitat distribution and relative abundance of amphibians in the Tampa Bay watershed (adapted from Layne et al. 1977).

	Habitat Type [a]													
Species	Pine-turkey oak	Sand pine scrub	Scrubby flatwoods	Typical flatwoods	Cabbage palm hammocks	Live oak hammocks	Mesic hammocks	Groves/parklands/etc.	Bay forest	Dry brushland	Dry prairie	Pasture/cropland/etc.	Artificial barrenland	Urban
Eastern Eastern newt *(Notophthalmus viridescens)*	–	–	–	–	–	V	–	–	–	–	–	–	–	–
Southern dusky salamander *(Desmognathus auriculatus)*	–	–	–	–	–	–	U	–	–	–	–	–	–	–
Slimy salamander *(Plethodon glutinosus)*	–	–	–	–	–	–	R	–	–	–	–	–	–	–
Eastern spadefoot *(Scaphiopus holbrooki)*	C	–	–	U	–	–	U	–	–	–	–	–	–	–
Greenhouse frog *(Eleutherodactylus planirostris)*	R	–	R	U	–	–	U	A	–	–	–	–	–	–
Southern toad *(Bufo terrestris)*	C	U	U	C	C	A	C	A	U	–	–	–	–	–
Oak toad *(Bufo quercicus)*	C	C	C	A	–	U	–	U	–	–	–	–	–	–
Giant toad *(Bufo marinus)*	–	–	–	–	–	–	–	S	–	–	–	–	–	–
Eastern narrow–mouthed toad *(Gastrophryne carolinensis)*	U	U	U	C	U	C	U	C	C	–	–	–	–	–
Green treefrog *(Hyla cinerea)*	–	–	–	–	–	–	–	U	U	–	–	–	–	–
Barking treefrog *(Hyla gratiosa)*	U	U	U	U	–	R	R	R	–	–	–	–	–	–
Pine woods treefrog *(Hyla femoralis)*	U	U	C	A	–	U	–	–	–	–	–	–	–	–
Squirrel treefrog *(Hyla squirella)*	C	U	C	C	C	A	U	A	U	–	–	–	–	C
Cuban treefrog *(Hyla septentrionalis)*	–	–	–	–	–	–	–	S	–	–	–	–	–	–
Little grass frog *(Limnaoedus ocularis)*	R	–	–	A	–	–	U	–	U	–	–	–	–	–
Chorus frog *(Pseudacris nigrita)*	R	–	–	U	–	–	–	–	–	–	–	–	–	–
Southern leopard frog *(Rana sphenocephala)*	–	–	–	U	U	–	–	–	U	–	–	–	–	–
Florida gopher frog *(Rana areolata [=capito] aesopus)*	U	R	R	V	–	–	–	–	–	–	–	–	–	–

[a] Relative abundance categories and abbreviations: Abundant (A), Common (C), Uncommon (U), Rare (R), Very rare (V), Breeding population (B), Population status questionable (S)

Appendix Table A-17. Wetland and aquatic habitat distribution and relative abundance of amphibians in the Tampa Bay watershed (adapted from Layne et al. 1977).

Species	Hardwood swamp	Cypress swamp	Mangrove swamp	Artificial swamp	Swamp thicket	Wet prairie	Freshwater marsh	Artificial marsh	Saltwater marsh	Dunes/beaches/flats	Lakes/ponds	Rivers/streams	Springs	Artificial fresh waters	Coastal/bays/estuaries	Offshore
	Habitat Type [a]															
Two–toed amphiuma *(Amphiuma means)*	U	U	–	U	C	–	U	U	–	–	C	U	U	C	–	–
Greater siren *(Siren lacertina)*	U	U	–	–	–	C	C	U	–	–	C	U	–	A	–	–
Lesser siren *(Siren intermedia)*	C	C	–	U	C	–	–	–	–	–	C	U	–	C	–	–
Dwarf siren *(Pseudobranchus striatus)*	R	R	–	–	U	C	C	–	–	–	U	R	–	U	–	–
Eastern newt *(Notophthalmus viridescens)*	U	U	–	–	–	–	R	R	–	–	U	U	–	V	–	–
Southern dusky salamander *(Desmognathus auriculatus)*	U	–	–	–	–	–	–	–	–	–	R	R	U	–	–	–
Dwarf salamander *(Eurycea quadridigitata)*	U	U	–	–	U	–	R	–	–	–	U	U	U	U	–	–
Eastern spadefoot *(Scaphiopus holbrooki)*	U	U	–	U	–	–	B	–	–	–	B	–	–	B	–	–
Greenhouse frog *(Eleutherodactylus planirostris)*	A	U	–	U	–	–	–	–	–	–	–	–	–	–	–	–
Southern toad *(Bufo terrestris)*	A	U	–	U	–	B	R	R	–	–	B	–	–	B	–	–
Oak toad *(Bufo quercicus)*	–	U	–	–	–	B	B	–	–	–	B	–	–	B	–	–
Giant toad *(Bufo marinus)*	–	–	–	–	–	–	–	–	–	–	B	–	–	B	–	–
Southern cricket frog *(Acris gryllus)*	U	U	–	U	U	A	A	A	–	–	A	U	U	A	–	–
Green treefrog *(Hyla cinerea)*	U	A	U	U	C	U	C	C	–	–	C	A	A	C	–	–
Barking treefrog *(Hyla gratiosa)*	R	R	–	–	–	B	B	–	–	–	B	B	–	B	–	–
Pine woods treefrog *(Hyla femoralis)*	R	U	–	–	–	B	B	B	–	–	B	B	–	B	–	–
Squirrel treefrog *(Hyla squirella)*	A	C	–	–	U	B	B	–	–	–	B	B	–	B	–	–
Cuban treefrog *(Hyla septentrionalis)*	–	–	–	–	–	–	–	–	–	–	–	–	–	B	–	–
Little grass frog *(Limnaoedus ocularis)*	R	U	–	–	U	C	C	U	–	–	A	C	–	C	–	–
Chorus frog *(Pseudacris nigrita)*	U	C	–	–	–	B	B	B	–	–	B	B	–	B	–	–
Eastern narrow–mouthed toad *(Gastrophryne carolinensis)*	C	U	–	U	C	B	B	–	–	–	B	B	–	B	–	–
Bullfrog *(Rana catesbeiana)*	U	U	–	–	U	U	U	C	–	–	C	C	–	C	–	–
Pig frog *(Rana grylio)*	U	U	–	–	U	C	C	C	–	–	C	C	–	C	–	–
Green frog *(Rana clamitans)*	S	S	–	–	–	–	–	–	–	–	–	S	–	–	–	–
Southern leopard frog *(Rana sphenocephala)*	A	C	R	C	U	A	A	C	U	–	A	C	U	A	–	–
Florida gopher frog *(Rana areolata aesopus)*	–	–	–	–	–	B	B	–	–	–	B	–	–	B	–	–

[a] Relative abundance categories and abbreviations: Abundant (A), Common (C), Uncommon (U), Rare (R), Very rare (V), Breeding population (B), Population status questionable (S).

Appendix Table A-18. Terrestrial habitats in which forest (arboreal) birds in the Tampa Bay watershed are found, including distribution, relative abundance, and seasonal occurrence (adapted from Layne et al. 1977; TI 1978c).

		Habitat type[b]							
Species	**Seasonal status [a]**	Pine-oak forest	Scrub pine flatwoods	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairies
White-winged dove (*Zenaida asiatica*)	W	-	R	R	-	-	-	-	R
Mourning dove (*Zenaida macroura*)	P	U	A	A	U	U	U	C	A
Commmon ground-dove (*Columbina passerina*)	P	-	A	A	-	-	-	C	A
Yellow-billed cuckoo (*Coccyzus americanus*)	S	-	-	-	C	C	C	-	-
Black-billed cuckoo (*C. erythropthalmus*)	M	-	-	-	R	R	R	-	-
Northern bobwhite (*Colinus virginianus*)	P	-	C	C	-	U	U	U	C
Wild turkey (*Meleagris gallopavo*)	P	U	U	U	U	U	U	U	U
Chuck-will's-widow (*Caprimulgus carolinensis*)	S	C	C	C	C	C	C	-	C
Whip-poor-will (*C. vociferus*)	W	U	U	U	U	U	U	-	U
Common nighthawk (*Chordeiles minor*)	S	-	C	A	-	-	-	-	A
Ruby-throated hummingbird (*Archilochus colubris*)	S	U	-	-	U	U	U	U	-
Northern flicker (*Colaptes auratus*)	P	C	C	C	U	U	U	U	-
Pileated woodpecker (*Dryocopus pileatus*)	P	U	-	U	U	U	U	-	-
Red-bellied woodpecker (*Melanerpes carolinus*)	P	C	U	C	C	C	C	C	-
Red-headed woodpecker (*M. erythrocephalus*)	P	U	-	U	U	U	U	-	-
Yellow-bellied sapsucker (*Sphyrapicus varius*)	W	C	-	U	C	C	C	U	-
Hairy woodpecker (*Picoides villosus*)	P	U	U	R	U	U	U	U	-
Downy woodpecker (*P. pubescens*)	P	C	C	U	C	C	C	C	-
Red-cockaded woodpecker (*P. borealis*)	P	-	-	R	-	-	-	-	-
Eastern kingbird (*Tyrannus tyrannus*)	S	-	U	C	C	C	C	U	-
Western kingbird (*T. verticalis*)	W	-	-	R	-	-	-	-	R
Scissor-tailed flycatcher (*Muscivora forficata*)	W	-	-	-	-	-	-	-	R
Great Crested flycatcher (*Myiarchus crinitus*)	P	U	-	U	C	C	U	-	-
Eastern phoebe (*Sayornis phoebe*)	W	-	-	-	C	C	U	-	-
Yellow-bellied flycatcher (*Empidonax flaviventris*)	M	R	R	-	R	R	R	-	-
Acadian flycatcher (*E. virescens*)	M	R	U	-	U	U	U	R	-
Least flycatcher (*E. minimus*)	M	R	R	-	U	U	U	-	-
Traill's flycatcher* (*E. traillii*)	M	R	R	-	U	U	U	-	-
Olive-sided flycatcher (*Nuttallornis borealis*)	M	-	R	-	-	-	-	-	-
Eastern wood-pewee (*Contopus virens*)	M	R	R	-	U	U	U	R	-
Tree swallow (*Iridoprocne bicolor*)	W	-	A	A	-	-	-	-	A
Barn swallow (*Hirundo rustica*)	M	-	-	-	-	-	-	-	U

Continued.

Appendix Table A-18. Continued.

Species	Seasonal status [a]	Habitat type[b]: Pine-oak forest	Scrub pine flatwoods	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairies
Blue jay (*Cyanocitta cristata*)	P	C	-	C	C	C	C	U	-
(Florida) Scrub jay (*Aphelocoma coerulescens coerulescens*)	P	U	-	-	-	-	-	-	-
Carolina chickadee (*Parus carolinensis*)	P	U	-	-	U	U	U	-	-
Tufted titmouse (*P. bicolor*)	P	U	-	-	C	C	C	-	-
White-breasted nuthatch (*Sitta carolinensis*)	P	-	R	R	R	R	R	-	-
Red-breasted nuthatch (*S. canadensis*)	W	-	R	R	R	R	R	-	-
Brown-headed nuthatch (*S. pusilla*)	P	-	U	U	-	-	-	-	-
Brown creeper (*Certhia americana*)	W	-	R	R	R	R	R	-	-
House wren (*Troglodytes aedon*)	W	U	U	U	U	U	U	U	-
Winter wren (*T. troglodytes*)	W	R	R	R	R	R	R	R	-
Bewick's wren (*Thryomanes bewickii*)	W	R	-	-	R	R	R	-	-
Carolina wren (*Thryothorus ludovicianus*)	P	C	C	C	A	A	C	C	-
Short-billed marsh wren (*Cistothorus platensis*)	W	-	-	-	-	-	-	-	U
Northern mockingbird (*Mimus polyglottos*)	P	A	A	A	C	C	C	C	A
Gray catbird (*Dumetella carolinensis*)	P	C	U	U	C	C	C	C	U
Brown thrasher (*Toxostoma rufum*)	P	C	U	U	C	C	C	C	U
American robin (*Turdus migratorius*)	W	C	C	C	C	C	C	C	A
Wood thrush (*Hylocichla mustelina*)	W	U	R	R	U	U	U	R	-
Hermit thrush (*Catharus guttatus*)	W	U	R	R	U	U	U	R	-
Swainson's thrush (*C. ustulatus*)	M	R	R	R	R	R	R	R	-
Gray-cheeked thrush (*C. minimus*)	M	R	R	R	R	R	R	R	-
Veery (*C. fuscescens*)	M	R	R	R	R	R	R	R	-
Eastern bluebird (*Sialia sialis*)	P	U	U	U	-	-	-	-	U
Blue-gray gnatcatcher (*Polioptila caerulea*)	P	C	U	U	C	C	C	U	-
Golden-crowned kinglet (*Regulus satrapa*)	W	U	R	R	U	U	U	R	-
Ruby-crowned kinglet (*R. calendula*)	W	C	U	U	C	C	C	U	-
Water pipit (*Anthus spinoletta*)	W	-	-	-	-	-	-	-	C
Cedar waxwing (*Bombycilla cedrorum*)	W	U	R	R	U	U	U	R	R
Loggerhead skrike (*Lanius ludovicianus*)	P	C	A	A	-	-	-	C	A
European starling (*Sturnus vulgaris*)	P	U	U	U	U	U	U	U	U
White-eyed vireo (*Vireo griseus*)	P	C	C	U	C	C	C	C	U
Yellow-throated vireo (*V. flavifrons*)	M	-	-	-	U	U	U	-	-
Solitary vireo (*V. solitarius*)	W	U	U	U	U	U	U	-	-

Continued.

Appendix Table A-18. Continued.

Species	Seasonal status [a]	Pine-oak forest	Scrub pine flatwoods	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairies
		Habitat type[b]							
Red-eyed vireo (*Vireo olivaceus*)	S	-	-	-	U	U	U	-	-
Philadelphia vireo (*V. philadelphicus*)	M	-	-	-	R	R	R	-	-
Warbling vireo (*V. gilvus*)	M	-	-	-	R	R	R	-	-
Black-and-white warbler (*Mniotilta varia*)	W	U	U	C	C	C	C	-	-
Worm-eating warbler (*Helmitheros vermivorus*)	M	-	-	-	R	R	R	-	-
Lawrence's warbler (*Helminthophaga lawrencei*)	M	-	-	-	R	R	R	R	-
Brewster's warbler (*H. leucobronchialis*)	M	-	-	-	R	R	R	R	-
Golden-winged warbler (*Vermivora chrysoptera*)	M	-	-	-	R	R	R	R	-
Blue-winged warbler (*V. pinus*)	M	-	-	-	R	R	R	R	-
Tennessee warbler (*V. peregrina*)	M	-	-	-	R	R	R	-	-
Orange-crowned warbler (*V. celata*)	W	U	-	-	U	U	U	-	-
Nashville warbler (*V. ruficapilla*)	M	-	-	-	R	R	R	-	-
Northern parula (*Parula americana*)	P	U	-	U	C	C	C	-	-
Yellow warbler (*Dendroica petechia*)	M	U	-	-	U	U	U	R	-
Magnolia warbler (*D. magnolia*)	M	R	-	-	R	R	R	-	-
Cape May warbler (*D. tigrina*)	M	-	-	-	U	U	U	-	-
Black-throated Blue warbler (*D. caerulescens*)	M	U	-	-	U	U	U	-	-
Yellow-rumped warbler (*D. coronata*)	W	A	C	C	A	A	A	C	-
Black-throated green warbler (*D. virens*)	M	U	U	U	U	U	U	-	-
Cerulean warbler (*D. cerulea*)	M	-	-	-	R	R	R	-	-
Blackburnian warbler (*D. fusca*)	M	R	-	-	R	R	R	-	-
Yellow-throated warbler (*D. dominica*)	P	U	U	U	U	U	U	-	-
Chestnut-sided warbler (*D. pensylvanica*)	M	R	-	-	R	R	R	-	-
Bay-breasted warbler (*D. castanea*)	M	R	-	-	R	R	R	-	-
Blackpoll warbler (*D. striata*)	M	-	-	-	R	R	R	-	-
Kirtland's warbler (*D. kirtlandii*)	M	-	-	-	R	R	R	-	-
Pine warbler (*D. pinus*)	P	U	C	C	R	R	R	-	-
Prairie warbler (*D. discolor*)	W	-	-	-	U	U	U	-	-
(Florida) Prairie warbler (*D. d. paludicola*)	P	-	-	-	-	-	R	-	-
Palm warbler (*D. palmarum*)	W	A	A	A	C	C	C	C	A
Ovenbird (*Seiurus aurocapillus*)	W	-	-	-	U	U	U	-	-
Kentucky warbler (*Oporornis formosus*)	M	-	-	-	R	R	R	-	-
Connecticut warbler (*O. agilis*)	M	-	-	-	R	R	R	-	-

Continued.

Appendix Table A-18. Continued.

Species	Seasonal status [a]	Habitat type[b]: Pine-oak forest	Scrub pine flatwoods	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairies
Mourning warbler (*Oporornis philadelphia*)	M	-	-	-	R	R	R	-	-
Common yellowthroat (*Geothlypis trichas*)	P	C	C	C	C	C	C	-	-
Yellow-breasted chat (*Icteria virens*)	M	-	-	-	R	R	R	R	-
Hooded warbler (*Wilsonia citrina*)	M	-	-	-	U	U	U	-	-
Wilson's warbler (*W. pusilla*)	M	-	-	-	R	R	R	-	-
Canada warbler (*W. canadensis*)	M	-	-	-	R	R	R	-	-
American redstart (*Setophaga ruticilla*)	M	-	-	-	C	C	C	U	-
Bobolink (*Dolichonyx oryzivorus*)	M	-	-	-	-	-	-	-	U
Eastern meadowlark (*Sturnella magna*)	P	U	A	A	-	-	-	-	A
Red-winged blackbird (*Agelaius phoeniceus*)	P	U	U	U	-	-	-	U	U
Orchard oriole (*Icterus spurius*)	S	-	-	-	R	R	R	-	-
Northern oriole (*I. galbula*)	W	-	-	-	R	R	R	-	-
Rusty blackbird (*Euphagus carolinus*)	W	-	-	-	U	U	U	-	U
Brewer's blackbird (*E. cyanocephalus*)	W	-	-	-	R	R	R	-	R
Boat-tailed grackle (*Quiscalus major*)	P	-	-	-	-	-	-	U	U
Common grackle (*Q. quiscula*)	P	-	-	-	-	-	-	U	U
Brown-headed cowbird (*Molothrus ater*)	W	-	-	-	U	U	U	-	U
Scarlet tanager (*Piranga olivacea*)	M	-	-	-	R	R	R	-	-
Summer tanager (*P. rubra*)	S	R	U	U	U	U	U	-	-
Northern cardinal (*Cardinalis cardinalis*)	P	C	R	R	C	C	C	U	-
Rose-breasted grosbeak (*Pheucticus ludovicianus*)	M	-	-	-	R	R	R	-	-
Blue grosbeak (*Guiraca caerulea*)	M	U	-	-	U	U	U	-	-
Indigo bunting (*Passerina cyanea*)	W	U	U	-	-	-	-	U	U
Painted bunting (*P. ciris*)	M	-	R	R	-	-	-	R	R
Dickcissel (*Spiza americana*)	W	-	-	-	-	-	-	-	R
American goldfinch (*Carduelis tristis*)	W	U	U	U	C	C	C	-	C
Rufous-sided towhee (*Pipilo erythrophthalmus*)	P	A	A	A	C	C	C	A	A
Savannah sparrow (*Passerculus sandwichensis*)	W	U	C	C	-	-	-	-	C
Grasshopper sparrow (*Ammodramus savannarum*)	W	-	-	-	-	-	-	-	U
(Florida) Grasshopper sparrow (*A. s. floridanus*)	P	-	R	-	-	-	-	-	R
Henslow's sparrow (*A. henslowii*)	W	-	-	-	-	-	-	-	R
Lark sparrow (*Chondestes grammacus*)	W	-	-	-	-	-	-	-	R
Bachman's sparrow (*Aimophila aestivalis*)	P	-	C	C	-	-	-	-	C

Continued.

Appendix Table A-18. Concluded.

Species	Seasonal status a	Habitat Type[b] Pine-oak forest	Scrub pine flatwoods	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairies
Dark-eyed junco (*Junco hyemalis*)	W	R	R	R	R	R	R	R	-
Chipping sparrow (*Spizella passerina*)	W	C	C	C	U	U	U	C	-
Field sparrow (*S. pusilla*)	W	U	U	U	R	R	R	U	-
White-crowned sparrow (*Zonotrichia leucophrys*)	W	R	R	R	-	-	-	R	R
White-throated sparrow (*Z. albicollis*)	W	R	R	R	-	-	-	R	R
Fox sparrow (*Passerella iliaca*)	W	R	-	-	-	-	-	R	R
Song sparrow (*Melospiza melodia*)	W	R	-	-	-	-	-	R	R

* Includes alder and willow flycatchers.

[a] P = Permanent resident; S = Summer resident (visitor); W = Winter resident (visitor); M = Migrant.

[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-19. Wetland habitats in which forest (arboreal) birds are found in the Tampa Bay watershed, including relative abundance and seasonal occurrence (adapted from Layne et. al. 1977, TI 1978c).

Species	Seasonal status[a]	Habitat type[b]: Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh
Mourning dove (*Zenaida macroura*)	P	-	U	-	-	-	-	-	-
Mangrove cuckoo (*Coccyzus minor*)	S	-	-	-	R	-	-	-	-
Yellow-billed cuckoo (*C. americanus*)	S	C	C	C	-	-	-	-	-
Black-billed cuckoo (*C. erythropthalmus*)	M	R	R	R	-	-	-	-	-
Northern bobwhite (*Colinus virginianus*)	P	-	-	-	-	-	U	-	-
Wild turkey (*Meleagris gallopavo*)	P	-	U	-	-	-	U	-	-
Chuck-will's-widow (*Caprimulgus carolinensis*)	S	C	C	C	-	-	-	-	-
Whip-poor-will (*C. vociferus*)	W	U	U	U	-	-	-	-	-
Ruby-throated hummingbird (*Archilochus colubris*)	S	U	U	U	-	-	-	-	-
Northern flicker (*Colaptes auratus*)	P	U	C	U	-	-	-	-	-
Pileated woodpecker (*Dryocopus pileatus*)	P	U	U	U	-	-	-	-	-
Red-bellied woodpecker (*Melanerpes carolinus*)	P	C	C	C	-	-	-	-	-
Red-headed woodpecker (*M. erythrocephalus*)	P	U	U	-	-	-	-	-	-
Yellow-bellied sapsucker (*Sphyrapicus varius*)	W	C	C	U	-	-	-	-	-
Hairy woodpecker (*Picoides villosus*)	P	U	U	U	-	-	-	-	-
Downy woodpecker (*P. pubescens*)	P	C	C	C	-	-	-	-	-
Eastern kingbird (*Tyrannus tyrannus*)	S	C	U	U	-	C	C	U	-
Gray kingbird (*T. dominicensis*)	S	-	-	-	C	-	-	-	-
Great crested flycatcher (*Myiarchus crinitus*)	P	C	C	C	-	-	-	-	-
Eastern phoebe (*Sayornis phoebe*)	W	U	U	U	-	U	C	C	-
Yellow-bellied flycatcher (*Empidonax flaviventris*)	M	R	R	R	-	-	-	-	-
Acadian flycatcher (*E. virescens*)	M	U	U	U	-	-	-	-	-
Least flycatcher (*E. minimus*)	M	U	U	U	U	-	-	-	-
Traill's flycatcher* (*E. traillii*)	M	U	U	U	-	-	-	-	-
Olive-sided flycatcher (*Nuttallornis borealis*)	M	-	-	-	-	R	-	R	-
Eastern wood-pewee (*Contopus virens*)	M	U	U	U	-	-	-	-	-
Tree swallow (*Iridoprocne bicolor*)	W	-	-	-	-	-	A	A	-
Bank swallow (*Riparia riparia*)	M	-	-	-	-	-	U	U	-
Southern rough-winged swallow (*Stelgidopteryx ruficollis*)	S	-	-	-	-	-	U	U	-
Barn swallow (*Hirundo rustica*)	M	-	-	-	-	-	U	U	-
Cliff swallow (*Petrochelidon pyrrhonota*)	M	-	-	-	-	-	U	U	-
Purple martin (*Progne subis*)	S	-	-	-	-	-	C	C	-
Blue jay (*Cyanocitta cristata*)	P	C	C	C	-	-	-	-	-
Carolina chickadee (*Parus carolinensis*)	P	U	U	U	-	-	-	-	-

Continued.

Appendix Table A-19. Continued.

Species	Seasonal status[a]	Habitat type[b]: Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh
Tufted titmouse (*Parus bicolor*)	P	C	C	C	-	-	-	-	-
White-breasted nuthatch (*Sitta carolinensis*)	P	R	R	R	-	-	-	-	-
Red-breasted nuthatch (*S. canadensis*)	W	R	R	R	-	-	-	-	-
Brown creeper (*Certhia americana*)	W	R	R	R	-	-	-	-	-
House wren (*Troglodytes aedon*)	W	U	U	U	-	U	-	-	-
Winter wren (*T. troglodytes*)	W	R	R	R	-	R	-	-	-
Bewick's wren (*Thryomanes bewickii*)	W	R	R	R	-	-	-	-	-
Carolina wren (*Thryothorus ludovicianus*)	P	A	A	A	-	C	-	-	-
Long-billed marsh wren (*Cistothorus palustris*)	W	-	-	-	-	-	U	U	U
(Marian's) Marsh wren (*C. palustris marianae*)	P	-	-	-	-	-	-	R	R
Short-billed marsh wren (*C. platensis*)	W	-	-	-	-	-	U	U	-
Northern mockingbird (*Mimus polyglottos*)	P	C	C	C	-	C	C	-	-
Gray catbird (*Dumetella carolinensis*)	P	C	C	C	-	C	U	-	-
Brown thrasher (*Toxostoma rufum*)	P	C	C	C	-	C	U	-	-
American robin (*Turdus migratorius*)	W	-	C	C	-	C	A	U	-
Wood thrush (*Hylocichla mustelina*)	W	U	U	U	-	-	-	-	-
Hermit thrush (*Catharus guttatus*)	W	U	U	U	-	-	-	-	-
Swainson's thrush (*C. ustulatus*)	M	R	R	R	-	-	-	-	-
Gray-cheeked thrush (*C. minimus*)	M	R	R	R	-	-	-	-	-
Veery (*C. fuscescens*)	M	R	R	R	-	-	-	-	-
Blue-gray gnatcatcher (*Polioptila caerulea*)	P	C	C	C	-	U	-	-	-
Golden-crowned kinglet (*Regulus satrapa*)	W	U	U	U	-	R	-	-	-
Ruby-crowned kinglet (*R. calendula*)	W	C	C	C	-	U	-	-	-
Water pipit (*Anthus spinoletta*)	W	-	-	-	-	-	C	C	-
Cedar waxwing (*Bombycilla cedrorum*)	W	U	U	U	-	R	-	-	-
Loggerhead skrike (*Lanius ludovicianus*)	P	-	-	-	-	C	C	-	-
European starling (*Sturnus vulgaris*)	P	U	U	U	-	U	-	-	-
White-eyed vireo (*Vireo griseus*)	P	C	C	C	-	C	-	-	-
Yellow-throated vireo (*V. flavifrons*)	M	U	U	U	-	-	-	-	-
Solitary vireo (*V. solitarius*)	W	U	U	U	-	-	-	-	-
Black-whiskered vireo (*V. altiloquus*)	S	-	-	-	C	-	-	-	-
Red-eyed vireo (*V. olivaceus*)	S	U	U	U	-	-	-	-	-
Philadelphia vireo (*V. philadelphicus*)	M	R	R	R	-	-	-	-	-
Warbling vireo (*V. gilvus*)	M	R	R	R	-	-	-	-	-
Black-and-white warbler (*Mniotilta varia*)	W	C	C	C	-	-	-	-	-
Prothonotary warbler (*Protonotaria citrea*)	S	-	U	U	-	U	-	-	-

Continued.

Appendix Table A-19. Continued.

Species	Seasonal status[a]	Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh
		Habitat type[b]							
Swainson's warbler (*Limnothlypis swainsonii*)	M	-	R	R	-	R	-	-	-
Worm-eating warbler (*Helmitheros vermivorus*)	M	R	R	-	-	-	-	-	-
Lawrence's warbler (*Helminthophaga lawrencei*)	M	R	-	-	-	-	-	-	-
Brewster's warbler (*H. leucobronchialis*)	M	R	-	-	-	-	-	-	-
Golden-winged warbler (*Vermivora chrysoptera*)	M	R	-	-	-	-	-	-	-
Blue-winged warbler (*V. pinus*)	M	R	-	-	-	-	-	-	-
Tennessee warbler (*V. peregrina*)	M	R	R	R	-	-	-	-	-
Orange-crowned warbler (*V. celata*)	W	U	U	U	-	-	-	-	-
Nashville warbler (*V. ruficapilla*)	M	R	R	R	-	-	-	-	-
Northern parula (*Parula americana*)	P	C	C	C	U	-	-	-	-
Yellow warbler (*Dendroica petechia*)	M	U	U	U	-	R	-	-	-
Magnolia warbler (*D. magnolia*)	M	R	R	R	-	-	-	-	-
Cape May warbler (*D. tigrina*)	M	U	U	U	-	-	-	-	-
Black-throated blue warbler (*D. caerulescens*)	M	U	U	U	-	-	-	-	-
Yellow-rumped warbler (*D. coronata*)	W	A	A	A	-	C	-	-	-
Black-throated green warbler (*D. virens*)	M	U	U	U	-	-	-	-	-
Cerulean warbler (*D. cerulea*)	M	R	R	R	-	-	-	-	-
Blackburnian warbler (*D. fusca*)	M	R	R	R	-	-	-	-	-
Yellow-throated warbler (*D. dominica*)	P	U	U	U	-	-	-	-	-
Chestnut-sided warbler (*D. pensylvanica*)	M	R	R	R	-	-	-	-	-
Bay-breasted warbler (*D. castanea*)	M	R	R	R	-	-	-	-	-
Blackpoll warbler (*D. striata*)	M	R	R	R	-	-	-	-	-
Kirtland's warbler (*D. kirtlandii*)	M	R	R	R	-	-	-	-	-
Pine warbler (*D. pinus*)	P	R	R	U	-	-	-	-	-
Prairie warbler (*D. discolor*)	W	U	U	U	-	-	-	-	-
(Florida) Prairie warbler (*D. discolor paludicola*)	P	-	-	-	C	-	-	-	-
Palm warbler (*D. palmarum*)	W	C	C	C	C	-	-	-	-
Ovenbird (*Seiurus aurocapillus*)	W	U	U	U	-	-	-	-	-
Northern waterthrush (*S. noveboracensis*)	M	-	R	R	-	R	-	-	-
Louisiana waterthrush (*S. motacilla*)	M	-	R	R	-	R	-	-	-
Kentucky warbler (*Oporornis formosus*)	M	R	R	R	-	R	-	-	-
Connecticut warbler (*O. agilis*)	M	R	R	R	-	R	-	-	-
Mourning warbler (*O. philadelphia*)	M	R	R	R	-	R	-	-	-
Common yellowthroat (*Geothlypis trichas*)	P	C	C	C	-	C	C	C	-
Yellow-breasted chat (*Icteria virens*)	M	R	R	R	-	R	-	-	-
Hooded warbler (*Wilsonia citrina*)	M	U	U	U	-	U	-	-	-

Continued.

Appendix Table A-19. Concluded.

Species	Seasonal status[a]	Habitat type[b]: Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh
Wilson's warbler (*Wilsonia pusilla*)	M	R	R	R	-	-	-	-	-
Canada warbler (*W. canadensis*)	M	R	R	R	-	-	-	-	-
American redstart (*Setophaga ruticilla*)	M	C	C	C	-	U	-	-	-
Eastern meadowlark (*Sturnella magna*)	P	-	-	-	-	-	U	-	-
Red-winged blackbird (*Agelaius phoeniceus*)	P	U	U	U	-	C	A	A	-
Orchard oriole (*Icterus spurius*)	S	-	R	-	-	-	R	R	-
Northern oriole (*I. galbula*)	W	-	R	-	-	-	R	R	-
Rusty blackbird (*Euphagus carolinus*)	W	-	U	U	-	U	-	-	-
Brewer's blackbird (*E. cyanocephalus*)	W	-	R	R	-	R	-	-	-
Boat-tailed grackle (*Quiscalus major*)	P	-	-	-	-	A	A	A	-
Common grackle (*Q. quiscula*)	P	U	U	U	-	U	U	U	-
Brown-headed cowbird (*Molothrus ater*)	W	-	U	U	-	U	U	U	-
Scarlet tanager (*Piranga olivacea*)	M	R	R	R	-	-	-	-	-
Summer tanager (*P. rubra*)	S	U	U	U	-	-	-	-	-
Northern cardinal (*Cardinalis cardinalis*)	P	C	C	C	-	U	-	-	-
Rose-breasted grosbeak (*Pheucticus ludovicianus*)	M	R	R	R	-	-	-	-	-
Blue grosbeak (*Guiraca caerulea*)	M	U	U	R	-	R	-	-	-
American goldfinch (*Carduelis tristis*)	W	C	C	-	-	C	U	-	-
Rufous-sided towhee (*Pipilo erythrophthalmus*)	P	C	C	C	-	U	U	-	-
Sharp-tailed sparrow (*Ammospiza caudacutus*)	W	-	-	-	-	-	-	-	R
(Scott's) Seaside sparrow (*A. maritima peninsulae*)	P	-	-	-	R	-	-	-	R
Dark-eyed junco (*Junco hyemalis*)	W	-	R	-	-	-	-	-	-
Chipping sparrow (*Spizella passerina*)	W	U	U	U	-	-	-	-	-
Field sparrow (*S. pusilla*)	W	R	R	R	-	-	-	-	-
Swamp sparrow (*Melospiza georgiana*)	W	-	-	-	-	-	C	C	-

* Includes Alder and Willow flycatchers.

a P = Permanent resident; S = Summer resident (visitor); W = Winter resident (visitor); M = Migrant.

b A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-20. Aquatic habitats in which forest (arboreal) birds are found in the Tampa Bay watershed, including relative abundance and seasonal occurrence (adapted from Layne et. al. 1977, TI 1978c).

Species	Seasonal status [a]	Habitat type [b] Lakes	Ponds	Springs	Streams	Coastal
Gray kingbird (*Tyrannus dominicensis*)	S	-	-	-	-	C
Scissor-tailed flycatcher (*T. forficatus*)	W	-	-	-	-	U
Eastern phoebe (*Sayornis phoebe*)	W	C	C	-	-	-
Tree swallow (*Iridoprocne bicolor*)	W	A	A	-	A	-
Bank swallow (*Riparia riparia*)	M	U	U	-	U	-
Southern rough-winged swallow (*Stelgidopteryx ruficollis*)	S	U	U	-	U	-
Barn swallow (*Hirundo rustica*)	M	U	U	-	U	-
Cliff swallow (*Petrochelidon pyrrhonota*)	M	U	U	-	U	-
Purple martin (*Progne subis*)	S	C	C	-	C	-
Carolina wren (*Thryothorus ludovicianus*)	P	-	-	-	-	-
Long-billed marsh wren (*Cistothorus palustris*)	W	U	U	-	U	-
(Marian's) Marsh wren (*C. palustris marianae*)	P	R	R	-	R	-
Water pipit (*Anthus spinoletta*)	W	C	C	-	C	-
Northern waterthrush (*Seiurus noveboracensis*)	M	R	R	-	R	-
Louisiana waterthrush (*S. motacilla*)	M	R	R	-	R	-
Common yellowthroat (*Geothlypis trichas*)	P	C	C	-	C	-
American redstart (*Setophaga ruticilla*)	M	C	C	-	C	-
Red-winged blackbird (*Agelaius phoeniceus*)	P	C	C	-	C	-
Boat-tailed grackle (*Quiscalus mexicanus*)	P	A	A	-	C	-
Common grackle (*Q. quiscula*)	P	C	C	-	-	-

[a] P = Permanent resident; S = Summer resident (visitor); W = Winter resident (visitor); M = Migrant.
[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-21. Habitat distribution, relative abundance, and seasonal occurrence of wading birds in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

		Habitat type[b]												
Species	Seasonal status[a]	Bayhead wetland	Mixed hardwood wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh	Lake	Pond	Spring	Stream	Coastal
Great blue heron (*Ardea herodias*)	P	-	U	U	C	C	C	C	C	C	C	-	C	C
Great white heron (*A. herodias occidentalis*)	P	-	-	-	R	-	-	-	-	R	-	-	-	R
Green-backed heron (*Butorides straitus*)	P	C	C	C	C	C	C	C	C	C	C	-	C	C
Cattle egret (*Bubulcus ibis*)	P	C	C	C	-	-	C	C	-	U	C	-	U	U
Great egret (*Casmerodius albus*)	P	C	C	C	C	C	C	C	C	C	C	-	C	C
Little blue heron (*Egretta caerulea*)	P	C	C	C	C	C	C	C	C	C	C	-	C	C
Reddish egret (*E. rufescens*)	P	-	-	-	R	-	-	-	-	-	-	-	-	R
Snowy egret (*E. thula*)	P	-	-	C	A	C	C	C	C	C	C	-	C	C
Tricolored heron (*E. tricolor*)	P	-	-	C	C	C	C	C	C	C	C	-	C	C
Black-crowned night heron (*Nycticorax nycticorax*)	P	-	-	U	C	U	U	U	U	U	U	-	U	U
Yellow-crowned night heron (*N. violaceus*)	P	-	-	U	C	C	U	U	C	U	U	-	U	U
Least bittern (*Ixobrychus exilis*)	P	-	-	-	-	-	U	U	U	-	-	-	-	-
American bittern (*Botaurus lentiginosus*)	W	-	-	-	-	-	U	U	U	-	-	-	-	-
Wood stork (*Mycteria americana*)	P	-	-	U	U	-	U	U	-	-	-	-	-	-
Glossy ibis (*Plegadis falcinellus*)	R	-	-	-	-	-	U	U	U	U	U	-	U	-
White ibis (*Eudocimus albus*)	R	-	-	-	A	-	C	C	-	C	C	-	C	C

Continued.

Appendix Table A-21. Concluded.

Species	Seasonal status[a]	Habitat type[b]: Bayhead wetland	Mixed hardwood wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh	Lake	Pond	Spring	Stream	Coastal
Scarlet ibis (*Eudocimus ruber*)	Ac	-	-	-	-	-	-	-	-	-	-	-	-	-
Roseate spoonbill (*Ajaia ajaja*)	S	-	-	-	C	-	-	-	-	C	C	-	C	C
(Greater)Sandhill crane (*Grus canadensis tabida*)	W	-	-	-	-	-	U	U	-	-	-	-	-	-
(Florida) Sandhill crane (*G. canadensis pratensis*)	P	-	-	-	-	-	U	U	-	-	-	-	-	-
Limpkin (*Aramus guarauna*)	P	R	R	-	-	R	-	R	-	-	-	-	R	-

[a] P = Permanent resident; S = Summer resident (visitor); W = Winter resident (visitor); Ac = Accidental (vagrant).
[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-22. Habitat distribution, relative abundance, and seasonal occurrence of floating and diving water birds in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

Species	Seasonal Status[a]	Habitat type[b]										
		Mangrove wetland	Swamp brushland	Wet prairies	Freshwater marsh	Saltwater marsh	Lakes	Ponds	Springs	Streams	Coastal	Offshore
Common loon (*Gavia immer*)	W	-	-	-	-	-	R	-	-	R	U	-
Red-throated loon (*G. stellata*)	W	-	-	-	-	-	-	-	-	-	R	-
Red-necked grebe (*Podiceps grisegena*)	W	-	-	-	-	-	-	-	-	-	R	-
Horned grebe (*P. auritus*)	W	-	-	-	-	-	R	-	-	R	C	-
Pied-billed grebe (*Podilymbus podiceps*)	P	-	-	-	-	-	C	C	-	U	-	-
American white pelican (*Pelecanus erythrorhynchos*)	P	-	-	-	-	-	U	-	-	U	U	-
Brown pelican (*P. occidentalis*)	P	C	-	-	-	-	R	-	-	R	C	-
Double-crested cormorant (*Phalacrocorax auritus*)	P	A	-	-	-	-	C	-	-	C	A	-
Anhinga (*Anhinga anhinga*)	P	-	-	-	-	-	C	-	-	C	C	-
Tundra swan (*Cygnus columbianus*)	W	-	-	-	-	-	R	R	-	R	R	-
Canada goose (*Branta canadensis*)	W	-	-	-	-	-	R	R	-	R	R	-
Snow goose (*Chen caerulescens*)	W	-	-	-	-	-	R	R	-	R	-	-
Fulvous Whistling-duck (*Dendrocygna bicolor*)	W	-	-	-	R	-	R	R	-	-	-	-
Mallard (*Anas platyrhynchos*)	W	-	-	-	R	-	R	R	-	R	-	-
American black duck (*A. rubripes*)	W	-	-	-	R	-	R	R	-	R	-	-
Mottled duck (*A. fulvigula*)	P	-	-	C	C	-	C	C	-	C	-	-
Gadwall (*A. strepera*)	W	-	-	-	-	-	R	R	-	R	-	-
Northern pintail (*A. acuta*)	W	-	-	-	-	-	U	U	-	U	-	-
Green-winged teal (*A. crecca*)	W	-	-	-	-	-	C	C	-	C	-	-
Blue-winged teal (*A. discors*)	W	-	-	-	C	-	C	C	-	C	-	-
American Wigeon (*A. americana*)	W	-	-	-	-	-	C	C	-	C	-	-
Northern shoveler (*A. clypeata*)	W	-	-	-	-	-	U	U	-	U	-	-
Wood duck (*Aix sponsa*)	P	-	C	U	U	-	U	U	-	U	-	-
Redhead (*Aythya americana*)	W	-	-	-	-	-	R	R	-	R	-	-
Ring-necked duck (*A. collaris*)	W	-	-	-	C	-	C	C	-	C	-	-
Canvasback (*A. valisineria*)	W	-	-	-	-	-	R	R	-	R	-	-
Greater scaup (*A. marila*)	W	-	-	-	-	-	-	-	-	-	R	-
Lesser scaup (*A. affinis*)	W	-	-	-	U	-	C	C	-	C	A	-
Common goldeneye (*Bucephala clangula*)	W	-	-	-	-	-	-	-	-	-	R	-
Bufflehead (*B. albeola*)	W	-	-	-	-	-	R	-	-	R	R	-
Oldsquaw (*Clangula hyemalis*)	W	-	-	-	-	-	-	-	-	-	R	R
Common elder (*Somateria mollissima*)	W	-	-	-	-	-	-	-	-	-	R	-

Continued.

Appendix Table A-22. Concluded.

Species	Seasonal Status[a]	Mangrove wetland	Swamp brushland	Wet prairies	Freshwater marsh	Saltwater marsh	Lakes	Ponds	Springs	Streams	Coastal	Offshore
		Habitat type[b]										
White-winged scoter (*Melanitta deglandi*)	W	-	-	-	-	-	-	-	-	-	R	-
Surf scoter (*M. perspicillata*)	W	-	-	-	-	-	-	-	-	-	R	-
Black scoter (*M. nigra*)	W	-	-	-	-	-	-	-	-	-	R	-
Ruddy duck (*Oxyura jamaicensis*)	W	-	-	-	-	-	U	U	-	U	R	-
Hooded merganser (*Lophodytes cucullatus*)	W	-	-	-	-	-	U	-	-	U	-	-
Common merganser (*Mergus merganser*)	W	-	-	-	-	-	R	-	-	R	R	-
Red-breasted merganser (*M. serrator*)	W	-	-	-	-	-	U	-	-	U	A	-
Purple gallinule (*Porphyrula martinica*)	S	-	-	U	U	-	U	U	-	U	-	-
Common moorhen (*Gallinula chloropus*)	P	-	-	C	C	-	C	C	-	C	-	-
American coot (*Fulica americana*)	W	-	-	C	A	U	A	A	-	A	U	-

[a] P =Permanent Resident; S =Summer Resident (visitor); and W =Winter Resident (visitor).
[b] A =Abundant; C =Common; U =Uncommon; and R = Rare.

Appendix Table A-23. Aquatic habitat distribution, relative abundance, and seasonal occurrence of birds of prey in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

Species	Status[a]	Lakes	Ponds	Springs	Streams	Coastal
		Habitat types[b]				
Short eared owl (*Asio flammeus*)	W	-	-	-	-	R
Bald eagle (*Haliaeetus leucocephalus*)	W	U	U	-	U	U
Northern harrier (*Circus cyaneus*)	W	-	-	-	-	C
Osprey (*Pandion haliaetus*)	P	U	U	-	U	-
Peregrine falcon (*Falco peregrinus*)	W	-	-	-	-	R
Merlin (*F. columbarius*)	W	-	-	-	-	R
American kestrel (*F. sparverius*)	W	-	-	-	-	C
(Southeast) American kestrel (*F. sparverius paulus*)	P	-	-	-	-	U
Magnificent frigatebird (*Fregata magnificens*)	P	R	-	-	R	U

[a] P = Permanent resident; W = Winter resident (visitor).
[b] C = Common; U = Uncommon; and R = Rare.

Appendix Table A-24. Wetland habitat distribution, relative abundance, and seasonal occurrence of birds of prey in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

Species	Seasonal status [a]	Habitat type[b]: Bayhead wetland	Mixed hardwood wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairies	Freshwater marsh	Saltwater marsh
Common barn owl *(Tyto alba)*	P	U	U	-	-	-	-	-	-
Eastern screech owl *(Otus asio)*	P	C	C	C	-	-	-	-	-
Great horned owl *(Bubo virginianus)*	P	C	C	U	-	-	-	-	-
(Florida)Burrowing owl *(Athena cunicularia floridana)*	P	-	-	-	-	-	-	-	-
Barred owl *(Strix varia)*	P	C	C	C	-	-	-	-	-
Short eared owl *(Asio flammeus)*	W	-	-	-	-	-	R	-	-
Turkey vulture *(Cathartes aura)*	P	C	C	C	-	-	C	-	-
Black vulture *(Coragyps atratus)*	P	C	C	C	-	-	C	-	-
American swallow tailed kite *(Elanoides forficatus)*	S	U	U	U	-	U	U	U	-
Mississippi kite *(Ictinia mississippiensis)*	W	R	R	R	-	R	R	R	-
Everglades kite *(Rostrhamus sociabilis plumbeus)*	P	-	-	-	-	-	R	R	-
Sharp-shinned hawk *(Accipiter striatus)*	W	U	U	U	-	-	-	-	-
Cooper's hawk *(A. cooperii)*	P	U	U	U	-	-	-	-	-
Red-tailed hawk *(Buteo jamaicensis)*	P	U	U	U	-	-	-	-	-
Red-shouldered hawk *(B. lineatus)*	P	C	C	C	-	C	C	-	-
Broad-winged hawk *(B. platypterus)*	W	U	U	U	-	-	-	-	-
Short-tailed hawk *(B. brachyurus)*	P	R	R	R	-	R	R	-	-
Rough-legged hawk *(B. lagopus)*	W	-	-	-	-	-	R	-	-
Bald eagle *(Haliaeetus leucocephalus)*	W	-	-	-	-	-	U	U	U
Northern harrier *(Circus cyaneus)*	W	-	-	-	-	-	C	C	C
Osprey *(Pandion haliaetus)*	P	-	-	-	U	-	U	U	U
Crested caracara *(Polyborus planeus)*	P	-	-	-	-	-	-	-	-
Peregrine falcon *(Falco peregrinus)*	W	-	-	-	-	-	R	R	R
Merlin *(F. columbarius)*	W	-	-	-	-	-	R	R	R
American kestrel *(F. sparverius)*	W	-	-	-	-	-	C	C	C
(Southeast) American kestrel *(F. sparverius paulus)*	P	-	-	-	-	-	U	U	U
Magnificent frigatebird *(Fregata magnificens)*	P	-	-	-	C	-	-	-	-

[a] P = Permanent resident; W = Winter resident (visitor).
[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-25. Terrestrial habitat distribution, relative abundance, and seasonal occurrence of birds of prey in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

		Terrestrial habitat type[b]				
Species	Seasonal status a	Pine-oak forest	Pine flatwoods	Cabbage-palm hammock	Mesic hammock	Live-oak hammock
Common barn owl (*Tyto alba*)	P	U	-	U	-	-
Eastern screech owl (*Otus asio*)	P	C	C	C	C	-
Great horned owl (*Bubo virginianus*)	P	C	C	C	-	-
(Florida)Burrowing Owl (*Athena cunicularia floridana*)	P	-	-	-	-	U
Barred owl (*Strix varia*)	P	C	C	C	-	-
Short eared owl (*Asio flammeus*)	W	-	-	-	-	R
Turkey vulture(*Cathartes aura*)	P	C	A	C	C	C
Black vulture (*Coragyps atratus*)	P	C	A	C	C	C
American swallow-tailed kite (*Elanoides forficatus*)	S	-	U	U	U	U
Mississippi kite (*Ictinia mississippiensis*)	W	R	R	R	R	R
Sharp-shinned hawk (*Accipiter striatus*)	W	U	U	U	-	-
Cooper's hawk (*A. cooperii*)	P	U	U	U	-	-
Red-tailed hawk (*Buteo jamaicensis*)	P	U	U	U	U	U
Red-shouldered hawk (*B. lineatus*)	P	C	C	C	C	C
Broad-winged hawk (*B. platypterus*)	W	-	U	U	-	-
Rough-legged hawk (*B. lagopus*)	W	-	R	-	-	R
Northern harrier (*Circus cyaneus*)	W	-	C	-	C	C
Crested caracara (*Polyborus plancus*)	P	-	R	-	R	R
American kestrel (*Falco sparverius*)	W	-	C	-	-	C
(Southeast) American kestrel (*F. sparverius paulus*)	P	-	U	-	-	U

[a] P = Permanent resident; S = Summer resident (visitor); W = Winter resident (visitor).
[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-26. Habitat distribution, relative abundance, and seasonal occurrence of probing shorebirds in the Tampa Bay watershed (adapted from Layne et al. 1977, TI 1978c).

Species	Seasonal status[a]	Habitat type[b]: Wet prairies	Freshwater marshes	Saltwater marshes	Lakes	Ponds	Springs	Streams	Coastal	Offshore
Ruddy turnstone *(Arenaria interpres)*	P	-	-	-	-	-	-	-	C	-
American woodcock *(Scolopax minor)*	W	see footnote [c]								
Common snipe *(Gallinago gallinago)*	W	C	C	-	C	C	-	C	-	-
Long-billed curlew *(Numenius americanus)*	W	-	-	-	-	-	-	-	R	-
Whimbrel *(N. phaeopus)*	W	-	U	U	-	-	-	-	U	-
Upland sandpiper *(Bartramia longicauda)*	M	see footnote [d]								
Spotted sandpiper *(Actitis macularia)*	W	-	-	-	U	U	-	U	U	-
Solitary sandpiper *(Tringa solitaria)*	M	-	-	-	U	U	-	U	-	-
Greater yellowlegs *(T. melanoleuca)*	W	C	C	-	C	C	-	U	C	-
Lesser yellowlegs *(T. flavipes)*	W	C	C	-	C	C	-	U	C	-
Willet *(Catoptrophorus semipalmatus)*	P	-	-	C	R	-	-	-	A	-
Sanderling *(Calidris alba)*	P	-	-	-	-	-	-	-	C	-
Dunlin *(C. alpina)*	P	-	-	-	-	-	-	-	-	C
Baird's sandpiper *(C. bairdii)*	W	-	-	-	R	R	-	-	R	-
Red knot *(C. canutus)*	P	-	-	-	-	-	-	-	C	-
White-rumped sandpiper *(C. fuscicollis)*	W	-	-	-	U	U	-	-	U	-
Stilt sandpiper *(C. himantopus)*	M	R	R	-	R	R	-	-	R	-
Purple sandpiper *(C. maritima)*	W	-	-	-	-	-	-	-	R	-
Western sandpiper *(C. mauri)*	W	-	-	-	C	C	-	-	C	-
Pectoral sandpiper *(C. melanotos)*	M	U	U	-	-	U	-	-	-	-
Least sandpiper *(C. minutilla)*	W	-	-	-	-	C	C	-	C	-
Semipalmated sandpiper *(C. pusilla)*	W	-	-	-	U	U	-	-	U	-
Ruff *(Philomachus pugnax)*	A	-	-	-	C	C	-	-	-	-
Short-billed dowitcher *(Limnodromus griseus)*	W	U	-	-	C	C	-	-	C	-
Long-billed dowitcher *(L. scolopaceus)*	W	R	-	-	R	R	-	-	R	-
Buff-breasted sandpiper *(Tryngites subruficollis)*	M	R	R	-	R	R	-	-	R	-
Marbled godwit *(Limosa fedoa)*	W	-	R	-	R	R	-	-	R	-
Hudsonian godwit *(L. haemastica)*	W	-	R	-	R	R	-	-	R	-
American avocet *(Recurvirostra americana)*	W	-	-	-	R	-	-	-	R	-
Black-necked stilt *(Himantopus mexicanus)*	S	-	-	-	U	U	-	-	U	-
Red phalarope *(Phalaropus fulicarius)*	M	-	-	-	-	-	-	-	R	R
Red-necked phalarope *(P. lobatus)*	M	-	-	-	-	-	-	-	R	R
Wilson's phalarope *(P. tricolor)*	M	-	R	-	-	-	-	-	R	R
King rail *(Rallus elegans)*	P	U	U	R	-	-	-	-	-	-
Clapper rail *(Rallus longirostris)* [e]	P	-	-	C	-	-	-	-	-	-

Continued.

Appendix Table A-26. Concluded.

Species	Seasonal status[a]	Wet prairies	Freshwater marshes	Saltwater marshes	Lakes	Ponds	Springs	Streams	Coastal	Offshore
		Habitat type[b]								
Clapper rail *(Rallus longirostris)* [e]	P	-	-	C	-	-	-	-	-	-
(Florida) Clapper rail *(R. longirostris scottii)* [f]	P	-	-	C	-	-	-	-	-	-
Virginia rail *(R. limicola)*	W	U	U	U	-	-	-	-	-	-
Sora *(Porzana carolina)*	W	U	U	U	-	-	-	-	-	-
Yellow rail *(Coturnicops noveboracensis)*	W	R	R	R	-	-	-	-	-	-
Black rail *(Laterallus jamaicensis)*	P	R	R	R	-	-	-	-	-	-
American oystercatcher *(Haematopus palliatus)*	P	-	-	-	-	-	-	-	R	-
Common ringed plover *(Charadrius hiaticula)*	Ac	-	-	-	-	-	-	-	-	-
Semipalmated plover *(C. semipalmatus)*	S	-	-	-	R	-	-	-	C	-
Piping plover *(C. melodus)*	W	-	-	-	-	-	-	-	U	-
(Cuban) Snowy plover *(C. alexandrinus tenuirostris)*	P	-	-	-	-	-	-	-	R	-
Wilson's plover *(C. wilsonia)*	P	-	-	-	-	-	-	-	C	-
Killdeer *(C. vociferus)* [g]	P	C	C	-	C	-	-	-	U	-
Lesser golden-plover *(Pluvialis dominica)*	M	-	-	-	-	-	-	-	R	-
Black-bellied plover *(P. squatarola)*	P	-	-	-	R	-	-	-	C	-

[a] P = Permanent Resident; S = Summer Resident (visitor); W = Winter Resident (visitor); M = Migrant; and Ac = Accidental (vagrant).
[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.
[c] rare in mixed hardwood wetlands and swamp brushland
[d] rare in dry prairies
[e] also common in mangrove wetlands
[f] also common in mangrove wetlands
[g] also uncommon in dry brushland

Appendix Table A-27. Habitat distribution, relative abundance, and seasonal occurrence of aerially searching birds in the Tampa Bay watershed (adapted from Layne et al. 1977; TI 1978c).

Species	Seasonal[a] status	Habitat type[b] Lakes	Ponds	Springs	Streams	Coastal
Glaucous gull (*Larus hyperboreus*)	W	-	-	-	-	R
Iceland gull (*L. glaucoides*)	W	-	-	-	-	R
Great black-backed gull (*L. marinus*)	W	-	-	-	-	U
Lesser black-backed gull (*L. fuscus*)	Ac	-	-	-	-	-
Herring gull (*L. argentatus*)	P	U	-	-	-	C
Ring-billed gull (*L. delawarensis*)	P	U	-	-	-	C
Common black-headed gull (*L. ridibundus*)	P	-	-	-	-	-
Laughing gull (*L. atricilla*)	P	U	-	-	-	A
Franklin's gull (*L. pipixcan*)	Ac	-	-	-	-	-
Bonaparte's gull (*L. philadelphia*)	W	R	-	-	-	U
Black-legged kittiwake (*Rissa tridactyla*)	Ac	-	-	-	-	-
Gull-billed tern (*Sterna nilotica*)	P	R	-	-	-	R
Forster's tern (*S. forsteri*)	W	U	-	-	-	C
Common tern (*S. hirundo*)	W	R	-	-	-	U
Roseate tern (*S. dougallii*)	W	-	-	-	-	R
Sooty tern (*S. fuscata*)	Ac	-	-	-	-	-
Bridled tern (*S. anaethetus*)	Ac	-	-	-	-	-
Least tern (*S. antillarum*)	P	U	-	-	-	C
Royal tern (*S. maxima*)	P	U	-	-	-	C
Sandwich tern (*S. sandvicensis*)	P	U	-	-	-	A
Caspian tern (*S. caspia*)	P	U	-	-	-	A
Black tern (*Chlidonias niger*)	M	C	-	-	-	A
Brown noddy (*Anous stolidus*)	Ac	-	-	-	-	-
Black skimmer (*Rynchops niger*)	P	U	-	-	-	C

[a] P = Permanent Resident; S = Summer Resident (visitor); W = Winter Resident (visitor); M = Migrant; and Ac = Accidental (vagrant).

[b] A = Abundant; C = Common; U = Uncommon; and R = Rare.

Appendix Table A-28. Terrestrial habitat distribution and relative abundance of mammals known or expected to occur in the Tampa Bay watershed (Layne et al. 1977, TI 1978c).

Species	Habitat types[a]								
	Pine-oak sandhills	Pine-oak scrub	Pine flatwoods scrub	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairie
Virginia opossum *(Didelphis virginiana)*	U	C	A	A	C	A	C	U	C
Southern short-tailed shrew *(Blarina carolinensis)*	-	-	-	-	-	U	-	-	-
Least shrew *(Cryptotis parva)*	U	C	U	R	-	-	-	-	U
Eastern mole *(Scalopus aquaticus)*	-	-	-	U	-	-	-	-	U
Southeastern myotis *(Myotis austroriparius)*	-	-	-	U	-	-	U	-	-
Big brown bat *(Eptesicus fuscus)*	-	-	-	U	U	-	U	-	-
Red bat *(Lasiurus borealis)*	-	-	-	-	R	-	R	-	-
Seminole bat *(L. seminolus)*	-	-	-	-	-	R	-	-	-
Northern yellow bat *(L. intermedius)*	-	-	-	-	-	R	-	-	-
Evening bat *(Nycticeius humeralis)*	-	-	-	U	-	-	-	-	-
Rafinesque's big-eared bat *(Plecotus rafinesquii)*	-	-	-	R	-	R	-	-	-
Nine-banded armadillo *(Dasypus novemcinctus)*[b]	U	C	C	A	C	A	C	C	A
Marsh rabbit *(Sylvilagus palustris)*	-	-	-	U	-	U	-	U	U
Eastern cottontail rabbit *(S. floridanus)*	U	U	C	A	U	U	U	C	A
Black-tailed jack rabbit *(Lepus californicus)*[b]	-	X	X	X	-	-	-	-	-
Gray squirrel *(Sciurus carolinensis)*	R	C	-	U	-	-	U	-	-
Sherman's fox squirrel *(S. niger shermani)*	U	U	-	U	-	-	R	-	-
Southern flying squirrel *(Glaucomys volans)*	-	U	-	U	-	U	U	-	-
Southeastern pocket gopher *(Geomys pinetus)*	R	-	-	R	-	-	-	U	C
Marsh rice rat *(Oryzomys palustris)*	-	-	-	R	-	R	-	-	-
Eastern harvest mouse *(Reithrodontomys humulis)*	-	-	R	U	-	-	-	U	U
Oldfield mouse *(Peromyscus polionotus)*	U	-	-	-	-	-	-	-	-
Cotton mouse *(P. gossypinus)*	U	A	A	U	U	C	U	-	U
Florida mouse *(P. floridanus)*	U	C	U	U	-	U	U	-	-
Golden mouse *(Ochrotomys nuttalli)*	-	-	-	U	-	R	-	-	-
Hispid cotton rat *(Sigmodon hispidus)*	U	C	C	A	-	-	-	C	A
Eastern woodrat *(Neotoma floridana)*	-	-	-	-	-	U	-	-	-
House mouse *(Mus musculus)*[b]	-	-	U	U	-	-	-	U	U
Coyote *(Canis latrans)*[b]	-	-	-	-	-	-	-	R	R
Red fox *(Vulpes vulpes)*[b]	-	-	-	R	-	-	-	R	R
Gray fox *(Urocyon cinereoargenteus)*	-	U	C	C	-	U	U	-	C
Florida black bear *(Ursus americanus floridanus)*	R	R	R	R	-	-	-	-	R

Continued.

Appendix Table A-28. Concluded.

Species	Pine-oak sandhills	Pine-oak scrub	Pine flatwoods scrub	Typical pine flatwoods	Cabbage palm hammocks	Mesic hammocks	Live oak hammocks	Dry brushland	Dry prairie
	Habitat types[a]								
Raccoon *(Procyon lotor)*	U	U	U	C	U	C	U	U	U
Florida long-tailed weasel (*Mustela frenata peninsulae)*	-	-	-	R	-	U	-	-	-
Spotted skunk (*Spilogale putorius)*	R	U	U	C	-	-	-	C	C
Striped skunk *(Mephitis mephitis)*	R	-	-	R	-	R	-	-	U
Florida panther *(Felis concolor coryi)*	R	R	-	R	-	-	-	-	-
Bobcat *(Lynx rufus)*	R	R	R	C	R	U	U	U	C
White-tailed deer *(Odocoileus virginianus)*	U	U	U	C	U	C	U	U	U
Wild hog *(Sus scrofa)*[b]	-	-	-	R	-	U	-	U	U

[a] A = Abundant, C = Common, U = Uncommon, R = Rare, X = Status Unknown.
[b] Exotic Species

Appendix Table A-29. Wetland habitat distribution and relative abundance of mammals known or expected to occur in the Tampa Bay watershed (Layne et al. 1977; TI 1978c).

Species	Habitat types[a]								
	Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh	Coastal area
Virginia opossum *(Didelphis virginiana)*	U	A	C	U	U	C	C	-	U
Southeastern shrew (*Sorex longirostris)*	-	U	-	-	-	-	-	-	-
Southern short-tailed shrew (*Blarina carolinensis)*	-	U	U	-	-	U	-	-	-
Least shrew *(Cryptotis parva)*	-	U	-	-	-	-	-	-	-
Eastern mole *(Scalopus aquaticus)*	-	C	-	-	-	-	-	-	-
Southeastern myotis *(Myotis austroriparius)*	-	U	-	-	-	-	-	-	-
Eastern pipistrelle *(Pipistrellus subflavus)*	-	X	-	-	-	-	-	-	-
Big brown bat *(Eptesicus fuscus)*	-	U	U	-	-	-	-	-	-
Red bat *(Lasiurus borealis)*	-	-	R	R	-	R	R	-	-
Hoary bat *(L. cinereus)*	-	U	-	-	-	-	-	-	-
Rafinesque's big-eared bat *(Plecotus rafinesquii)*	-	R	R	-	-	R	R	-	-
Brazilian free-tailed bat *(Tadarida brasiliensis)*	-	U	-	-	-	-	-	-	-
Nine-banded armadillo*(Dasypus novemcinctus)*[b]	R	C	U	-	U	C	-	-	U
Marsh rabbit *(Sylvilagus palustris)*	-	U	U	-	C	A	C	-	-
Eastern cottontail rabbit *(S. floridanus)*	-	U	U	-	U	A	U	-	C
Eastern gray squirrel *(Sciurus carolinensis)*	-	A	C	-	-	-	-	-	-
Sherman's fox squirrel *(S. niger shermani)*	-	U	-	-	-	-	-	-	-
Southern flying squirrel *(Glaucomys volans)*	-	C	R	-	-	-	-	-	-
Southeastern pocket gopher *(Geomys pinetus)*	-	R	-	-	-	-	-	-	-
Rice rat *(Oryzomys palustris)*	-	-	R	-	C	A	C	-	-
Oldfield mouse *(Peromyscus polionotus)*	-	-	-	-	-	-	-	-	C
Cotton mouse *(P.gossypinus)*	-	A	U	-	-	-	-	-	-
Golden mouse *(Ochrotomys nuttalli)*	-	U	U	-	U	-	-	-	-
Hispid cotton rat *(Sigmodon hispidus)*	-	R	-	-	U	C	-	-	-
Eastern woodrat *(Neotoma floridana)*	-	C	U	-	-	-	-	-	-
Round-tailed muskrat *(Neofiber alleni)*	-	-	R	-	-	R	U	-	-
Nutria *(Myocastor coypus)*[b]	-	-	-	-	-	R	R	-	-
Coyote *(Canis latrans)*[b]	-	R	-	-	-	-	-	-	-
Red fox *(Vulpes vulpes)*[b]	-	R	-	-	-	R	-	-	-
Gray fox *(Urocyon cinereoargenteus)*	-	R	R	-	-	C	-	-	-
Florida black bear *(Ursus americanus floridanus)*	-	R	R	-	-	-	-	-	-
Raccoon *(Procyon lotor)*	U	C	C	U	C	C	C	-	-
Florida long-tailed weasel (*Mustela frenata peninsulae)*	-	U	U	-	-	U	-	-	-

Continued.

Appendix Table A-29. Concluded.

Species	Bayhead wetland	Mixed hardwoods wetland	Cypress wetland	Mangrove wetland	Swamp brushland	Wet prairie	Freshwater marsh	Saltwater marsh	Coastal area
	Habitat types[a]								
Florida mink *(Mustela vison lutensis)*	-	-	R	-	-	R	R	-	-
Striped skunk *(Mephitis mephitis)*	-	U	R	-	-	R	-	-	-
River otter *(Lutra canadensis)*	-	U	C	U	U	U	C	-	U
Florida panther *(Felis concolor coryi)*	R	R	R	-	R	-	-	-	-
Bobcat *(Lynx rufus)*	R	U	U	-	U	U	-	-	-
Jaguarundi *(F. yagouaroundi)*[b]	-	X	-	-	-	-	-	-	-
White-tailed deer *(Odocoileus virginianus)*	-	C	U	-	-	U	-	-	R
Wild hog *(Sus scrofa)*[b]	-	C	U	-	U	U	U	-	-

[a] A = Abundant, C = Common, U = Uncommon, R = Rare, X = Status Unknown.
[b] Exotic Species.

Appendix Table A-30. Aquatic habitat distribution and relative abundance of mammals known or expected to occur in the Tampa Bay watershed (Layne et al. 1977; TI 1978c).

Species	Lakes	Ponds	Springs	Streams	Offshore
	Habitat types[a]				
Round-tailed muskrat *(Neofiber alleni)*	R	R	R	R	-
Nutria *(Myocastor coypus)*[b]	R	R	-	-	-
Bottled-nosed dolphin *(Tursiops truncatus)*	-	-	-	-	R
Florida mink *(Mustela vison lutensis)*	R	R	R	R	-
River otter *(Lutra canadensis)*	U	U	U	C	-
Manatee *(Trichechus manatus)*	-	-	R	R	R

[a] C = Common, U = Uncommon, R = Rare.
[b] Exotic Species.