

*Tropical Lake Ecology Assessment
With Emphasis on Changes in
Salinity of Lakes
Project No.SAA-140714
Technical Memorandum # 2
Inventory of Flora and Fauna*

*Prepared for:
Panama Canal Authority*

*Prepared by:
URS Holdings, Inc.*

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ANNEX

1.0 INTRODUCTION

The Panama Canal Authority (ACP) is currently performing a series of studies to assess the feasibility of a new set of locks, alternative systems to raise and lower vessels, and upgrading the navigation channel to prepare a Master Plan for the Modernization and Expansion of the Canal. Part of these studies includes the analysis of risks to increase the salinity of the lakes Gatun and Miraflores. This may occur as a consequence of increased traffic, lateral water saving basins, and anticipated structural modifications, which include an additional set of locks to accommodate larger Post-Panamax vessels. Lake Gatun is adjacent to the locks on the Atlantic and Pacific sides of the Canal and Miraflores Lake is adjacent to the locks on the Pacific side of the Canal.

Within this context, ACP retained URS Holdings, Inc. (URS) for the execution of the contract for the Tropical Lake Ecology Assessment with Emphasis on Changes in Salinity of Lakes. More specifically, under this agreement, URS shall recommend the maximum salinity levels, which may be tolerated in the lakes mentioned above. The salinity standards must consider the current procedures for treatment of potable water in Panama and must also maintain the biological integrity of freshwater ecosystems.

The terms of reference specify several intermediate products in the form of technical memoranda. In this context, this is the second technical memorandum, which deals with the inventory of flora and fauna within the study area.

1.1 OBJECTIVE

Based on the previous paragraphs, the objective of this second technical memorandum is to present the results of the research and review of flora and fauna information, and to use this information to identify potentially sensitive species in the lakes.

1.2 BACKGROUND

During the preparation of this Technical Memorandum, published literatures as well as consulting studies were reviewed to develop the inventory of flora and fauna for Gatun and Miraflores Lakes. Over 90 different sources of information were identified (and also provided by ACP) and reviewed. The relevant species of flora and fauna were organized in tabular form and summarized in text and tables. Also, the names of species were updated to reflect scientific changes and findings. The most important sources of information consulted, due to their content, clarity and/or subject matter are listed below:

Table 1-1
List of Most Relevant Sources of Information

Document Name	Author	Year	Source of Information
Possible Effects of Sea Water Introduction to the Habitats of Aquatic Insects in gatun Lake	Hogue, Charles L.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Shore Vegetation	Teas, Howard	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal

Document Name	Author	Year	Source of Information
Considerations on Effects of Salinity on Aquatic Macrophyte Communities Growing in Gatun Lake.	Pasco, Ricardo A.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Salinity Considerations of Freshwater Fish of the Panama Canal System	Bozeman, E.L. & Dean, J.M.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Probable Environmental Impact of Salinity Change on Marine Wood Borers.	Menzies, Robert J.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
General Marine Invertebrates	Mariscal, Richard N.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Possible Impact of Salinity Changes in the Panama Canal System on Marine Phytoplankton	Iverson, Richard L.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Freshwater Zooplankton	Hurlbert, Stuart H.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Marine Plants	Humm, Harold, J.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Projections on the Effects of the Salinization of Gatun Lake on Insects of Medical Importance.	Boreham, Melvin M.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Excavating Sponges as Fouling Organism	Bakus, Gerald J.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
The Mollusc of the Panama Canal	Greenberg, Michael J.	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
The Decapod Crustacean Fauna of the Panama Canal and Adjacent Waters	Abele, Lawrence	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal
Mollusks of The Tropical Eastern Pacific. Particularly from the Southern Half of the Panamic-Pacific Faunal Province (Panama to Peru). Panamic-Pacific Pelecypoda.	Olsson, Axel A.	1961	Paleontological Research Institution. Ithaca, N.Y.
El inventario Biológico del Canal de Panamá. IV. El Estudio de Aguas Continentales y Entomológico.	Gutiérrez, R. Et al	1994	Scentia (edición especial), Diciembre de 1995.
El inventario Biológico del Canal de Panamá. I. El Estudio Marino	D'Croz, L., Martínez V. & Arosemena, G.	1994	Scentia (edición especial), Enero de 1994.
Microalgas presentes en el Fitobentos Colectado en el Canal de Panamá (Esclusas de Pedro Miguel)	Pérez, María I. & Aguilar, Edilberto	2001	Tecnociencia 2001, Vol.3 No.1
The Decapod Crustaceans of The Panama Canal.	Abele, Lawrence & Won Kim	1989	Smithsonian Contributions to Zoology, Number 482. 1989.
Marine Fishes of Panama as Related to the Canal	Gunter, Gordon	1974	Sea Water Pumping Environmental Study Phase I. Panama Canal

A full list of documents is provided as section 4.0 of this Technical Memorandum.

1.3 STRUCTURE

This Technical Memorandum has been organized in a manner that is consistent with the objectives of the document and that will allow a clear and concise presentation of the researched information, and its significance. The structure of the document is briefly discussed in the next paragraphs.

Introduction. This introductory section contains a general description of the work to be carried out by URS as well as the objective, and structure for the Technical Memorandum. In addition, background narrative that explains the research activities performed and the relevant information used is also presented.

Flora and Fauna Inventory. This section is the primary result of Task 2 of the project and presents and organizes the information that was identified and reviewed. The section has been organized into three sub-sections that contain the identification of species of flora and fauna; a comparison of species between the lakes; and the identification of important species.

Conclusions. This section presents basic conclusions applicable to Task 2 of the project (Inventory of flora and fauna).

2.0 INVENTORY OF FLORA AND FAUNA

In order to compile an inventory of the Flora and Fauna species associated to Gatun and Miraflores lakes (Figure 2-1), the URS team reviewed the available literature, and the most recent biological inventories performed by the University of Panama for the Panama Canal Authority (UP-ACP04). In addition, the team conducted a review of the nomenclature status and updated taxonomy of the species reported in the above-mentioned lakes and vicinity. To that end, the team consulted the electronic databases described in the previous chapter by means of the Internet.

ACP's Environmental Management Division has also carried out salinity measurements. The most recent measurement was made last year, and measurements are scheduled for the 2005 dry season. The main conclusion that can be drawn from the past salinity measurements is that the salt concentration in Gatun Lake is almost negligible; while Miraflores Lake has a salt concentration of up to 3 ppt.

The salt concentrations in the Atlantic and Pacific Entrances are lower than salt concentration in the oceans, particularly near the water surface at the locks (Delft, 2003). These conditions have allowed the establishment of a marine biota in the locks systems on both sides of the Canal, Figure 2-1.

Finally, special information relevant to each species was recorded in the remarks column of tables 2.1-2.7. These remarks include the common name of each species, which is indicated in bold, whenever it was available.

2.1 REPORTED SPECIES

2.1.1 Plant Species

The plant species identified in lakes Gatun, Miraflores and in the Panama Canal entrances were divided into three main groups:

- Algae: including the species associated to freshwater and marine environments, as well as those species that can be classified as micro (freshwater and marine phytoplankton) and macro-algae that inhabit mainly in marine environments.
- Aquatic macrophytes: including marginal, emergent, and floating species; and the Flora associated to the border of lakes,
- Mangroves: including the species from several plant groups, which are present in this type of ecosystem.

2.1.1.1 Algae

A total of 147 species of algae distributed in 6 taxonomic groups (Division), were reported for Lake Gatun, where the Chlorophyta presented the major number of micro algae species (66), mainly unicellular (*Desmidium baileyi* var. *baileyi fo. tetragonum* Nordstedt), and colonial (*Volvox aureus* Ehrenberg). Another groups with a large quantity of species was the

Bacillariophyta with 34 micro algae species (*Melosira granulata* (Ehrenberg) Ralfs, the Cyanophyta group with 33 species, which present mainly unicellular (*Chroococcus limneticus* Lemmermann), filamentous (*Lyngbya cf. Lagerheimii* (Moebius) Gomont) and colonial forms (*Nostoc plancticum* Poretsky & Tschernow). Finally, the groups with the lowest number of species reported were the Euglenophyta group with 4 unicellular species (*Euglena sp*, *Phacus cf. pleuronectes* (O.F.M.) Duj Fa), and Dinophyta 4 micro algae species (*Ceratium hirundinella* (O.F. Müller) Bergh), Table 2-1.

A total of 25 species, distributed in 3 principal groups were reported in the Miraflores Lake, where the Diatoms or Bacillariophyta group presented the largest number with 14 species. Eight (8) species also were reported for Gatun Lake (*Aulacoseira cf. ambigua* (Grunow) Simonsen, *Actinocyclus sp.*, *Eunotia sp.*, etc.). The rest of the species were reported also for the Pacific entrance of the Canal (*Coscinodiscus asteromphalus* Ehrenberg); the other group reported with more species was the green algae or Chlorophyta with 9 species, which also are registered in Gatun Lake (*Terpsinoe musica* Ehrenberg, *Eudorina elegans* Ehrenberg). Miraflores Lake has the same predominance of forms previously described for Gatun Lake. On the other hand, the next group presented a lesser number of species was the Cyanophyta (2).

Most diatoms (Bacillariophyta) were reported from the Pacific entrance to the Panama Canal (103 ssp.); from those, 15 species were reported from the Atlantic entrance, while 10 species were found in both oceans. Among those found in both oceans we can mention *Bacteriastrum delicatulum* Cleve, *Chaeotceros coarctatus* Lauder, *Thalassionema nitzschiooides* Grun, and *Skeletonema costatum* (Greville) Cleve. A greater diversity of truly marine species (94) than fresh water species (24) was reported. The families with more species in the Pacific Ocean are the Chaetocerotaceae (*Chaetoceros sp.*), and the Rhizosoleniaceae family with prevalence of the genus *Rhizosolenia* sp., and with less species of *Odontella* sp. and *Guinardia* sp. On the Atlantic side, a strong dominance of families as shown in the Pacific entrance was not observed.

Table 2-1
Number of Algae Species at the Gatun and Miraflores Lakes, and at both Entrances to the Panama Canal.

Taxonomic Group	Total Number of Species	Gatun Lake	Miraflores Lake ¹	Marine		FW/Ma
				A	P	
Bacillariophyta	127	34	14	15	103	17
Chlorophyta	96	66	9	30	6	--
Cyanophyta	36	33	2	1	1	17
Dinophyta	28	4	--	--	24	--
Rhodophyta	15	--	--	--	15	--
Chrysophyta	8	6	--	--	2	2
Phaeophyta	5	--	--	5	--	--
Euglenophyta	4	4	--	--	--	--
Xanthophyta	1		--	1	--	--
Total	320	147	25	52	151	36

FW Gatun: Freshwater species in Gatun Lake. Ma (P/A): Atlantic and Pacific marine species. FW/Ma: species present in both environments.

1: Number of species gathered from the 2004 biological Inventory raised by the Panama University to the ACP. Source: Prepared by URS on the basis of the bibliographic information consulted, and the 2004 Biological Inventory, University of Panama - Panama Canal Authority.

Within the marine Chlorophyta a higher diversity has been reported from the Caribbean (30 ssp.), while in the Pacific side, only 6 species have been reported, which have a high grade of cellular organization (currently named macro algae). The species reported for the Pacific entrance also have been reported for the Atlantic side. Among those species present in both oceans are the filamentous and unicellular algae *Rhizoclonium riparium* (Roth) Harvey, *R. riparium* var. *implexum* (Dillwyn) Rosenvinge, and the macroalgae *Caulerpa peltata* J.V. Lamouroux. Most species reported in the marine environment on both coasts were species with high degree of multicellular complexity, being the most outstanding ones: *Halimeda copiosa* Goreau & E.A. Graham, *Halimeda discoidea* Decaisne, *Codium isthmocladum* Vickers, *Penicillus capitatus* Lamarck, and *Caulerpa sertularioides* (S.G. Gmelin) M. Howe, among others (see Table 2-1 in the annex).

The species diversity of marine Cyanophyta or blue-green algae was low, with only 2 micro algae species that have been reported to the Pacific and Atlantic entrances of the Canal (*Sirocoleum kurzii* (Zeller) Gomont and *Porphyrisiphon miniatus* (Hauck)

The marine Dinoflagellate was abundant only on the Pacific entrance of the Canal, with a total of 24 species. Among these micro algae species are *Ceratium candelabrum* (Ehrenberg) Stein, *Noctiluca scintillans* (Macartney) Ehrenberg, *Peridinium pendunculatus* Schütt, and *Pyrocystis fusiformis* Wyville - Thomson & Blackman, among others (see Table 2-1A in the annex).

Fifteen (15) red macro algae or Rhodophytas species strictly marine with a multicellular and that were reported only for the Atlantic entrance of the Canal (Table 2-1), were the most outstanding ones *Hypnea spinella* (C. Agardh) Kützing, *Spyridia filamentosa* (Wulfen) Harve, *Acanthophora spicifera* (M. Vahl) Børgesen.

All the brown algae species, or Phaeophyta, (5 spp) reported are truly marine species and exclusively from the Atlantic side of the Canal and were not reported to both lakes, (*Lobophora variegata* (Lamouroux) Womersley ex Oliveira, *Hincksia mitchelliae* (Harvey) P.C. Silva).

Within the marine Chrysophyta, or golden brown algae, only two species were registered on the Pacific entrance, to the Atlantic entrance was not recorded this group (*Dictyocha fibula* Ehrenberg and *Distephanus speculum* (Ehrenberg) Haeckel).

All euglenoides or Euglenophyta were reported only for Lake Gatun. They included 4 species: *Euglena* sp. (2 undetermined species), *Phacus cf. pleuronectes* (O.F.M.) Duj Fa, and *Trachelomonas ensifera* fo. *dentifera* Prescott. This group has not been reported to the Miraflores Lake and both entrances of the Canal.

The marine Xanthophyta group present just 1, this specie was recorded on the Atlantic side of the Canal (*Vaucheria dichotoma* (Linnaeus) Martius).

In general terms, we can say that in the area under study that includes Gatun and Miraflores lakes and the Pacific and Atlantic Entrances of the canal, a total of 320 species of algae distributed in 9 main taxonomic groups (Division). They were reported in the consulted literature or in the recent

inventories carried out in the Gatun and Miraflores lakes, and in the Atlantic and Pacific entrances to the Panama Canal (Table 2-1A in the annex). Among the prevailing groups in this data collection are the following: 127 species (ssp.) of diatoms or Bacillariophyta; 96 ssp. of green algae or Chlorophyta; 36 species of blue-green algae or Cyanophytas; 28 species of dinoflagellates or Dynophyta (also known as Phyrrophyta), and a few red algae, or Rhodophytas, species (15), 8 spp of golden-brown algae or Chrysophytas; 5 ssp. of brown algae, Phaeophyta; 4 species of Euglenophyta, and only 1 species of Xanthophyta (Table 2-1).

2.1.1.2 Aquatic Macrophytes and Associated Flora to the Lakes Shoreline

A total of 74 species was reported for the Lake Gatún, where 54 species were registered for the Lake, 9 species are common for the lakes Gatun and Miraflores, 7 were found in Gatun and in the Atlantic side, other 3 species were registered for Gatun and both entrances of the Canal, finally, only 1 species was identified for Pedro Miguel Locks y Lake Gatun. In Miraflores Lake was found 13 species, while 4 species are own of Miraflores Lake and 9 species are in common for both lakes.

As seen in the Table 2-2, the greatest diversity of marginal species is observed at Lake Gatún (38), where 25 species only have been registered for the lake Gatún, other two are common to Gatun and Miraflores Lakes (*Fuirena umbellata* Rottb. and *Oriza latifolia* Desv.), 7 species have been reported in common to Gatun and the Atlantic side of the Canal, 3 species were found in Gatun, Atlantic and Pacific entrances of the canal. One species was common to Lake Gatún and the Pedro Miguel Locks, which was found at the exit of Lake Gatún towards Miraflores, (*Panicum grande* Hitchc. & Chase); however, this is a species with wide distribution, and may be found in other sites of the watershed and of the country. Within the marginal group there are some species associated to the lake shoreline, such as: *Pachira aquatica* Aubl., *Manicaria saccifera* Gaertn., *Brownea macrophylla* Linden, amongst others (see Table 2-2 A in the annex).

Table 2-2
Totals and Distribution of Aquatic Macrophytes Reported at the Gatun and Miraflores Lakes, and at the Atlantic and Pacific Entrance to the Panama Canal

Macrophytes	Total Number of Species											Total	Total	Total				
		G		M		G/M		A		P								
		Gatun	Miraflores	Pacific	Atlantic													
Marginal	54	25	1	2	7	3	5	7	3	1	38	3	6	19				
Emergent	19	13	3	1	--	--	2	--	--	--	14	4	2	2				
Floating	10	6	--	4	--	--	--	--	--	--	10	4	--	--				
Submerged	12	10	--	2	--	--	--	--	--	--	12	2	--	--				
Total	95	54	4	9	7	3	7	7	3	1	74	13	8	21				

Prepared by URS on the basis of the bibliographic information consulted, and the 2004 Biological Inventory, University of Panama - Panama Canal Authority. G: Gatun – M: Miraflores – A: Atlantic – P: Pacific – PDM: Pedro Miguel Locks

Three (3) species were reported in Miraflores, while one species only was registered for this lake (*Luziola* sp.), others two were common for both lakes.

Most emergent species were reported for Gatun Lake (14), 4 species were recorded for Miraflores (*Nymphoides* sp., *Eleocharis* sp., and *Polygonum acuminatum* Kunth), while 1 species was in common to both lakes (*Eichhornia azurea* (Sw.) Kunth).

Twelve submerged species were reported at Lake Gatun, in Miraflores Lake was reported 2 species that has been reported also in Gatun Lake (*Ceratophyllum demersum* L. and *Hydrilla verticillata* (L. f.) Royle).

Within the floating species functional group, 6 species were reported at Gatun Lake, and 4 at Miraflores Lake, which also were reported for Gatun (*Salvinia auriculata* Aubl., *Pistia stratiotes* L., *Eichhornia crassipes* (Mart.) Solms and *Azolla caroliniana* Willd).

For the Atlantic coast 7 species were reported, 3 for the Pacific side of the Canal, and 5 species are found at both coasts. Besides, 3 species are found in both coasts and at Lake Gatun (*Montrichardia arborescens* (L.) Schott, *Thalia geniculata* L., and *Pachira aquatica* Aubl.).

A total of 95 species of Macrophytes were reported for lakes Gatun, Miraflores and the Pacific and Atlantic entrances of the Panama Canal; distributed in 4 main functional groups (marginal, emergent, floating, and submerged macrophytes). The largest number of species was recorded among the marginal group, which amounted to a total of 54 species (Table 2-2). Within the emergent species, 19 species were reported. A total of 10 species of floating macrophyte were identified and 12 submerged species were reported.

2.1.1.3 Mangroves

Table 2-3 of the annexes shows the main mangrove species found at both entrances of the Panama Canal. A total of 11 species are reported, 4 are only found at the Pacific entrance to the Canal (*Rhizophora racemosa* G. Mey., *Rhizophora X. harrisonii* Leechm., Triana, Ducke, and *Tabebuia palustris* Hemsl., while the remaining 7 species are found at both entrances to the Canal, among them *Rhizophora mangle* L., *Pelliciera rhizophorae* Triana & Planch, and *Laguncularia racemosa* (L.) Gaertn. F. Out of the above-mentioned seven species, one is also found at Lake Gatun (*Cassipourea elliptica* (Sw.) Poit.).

2.1.2 Animal Species

The fauna reported for Gatun and Miraflores lakes was made up of 114 and 44 species respectively; additional other 43 species were found in common to both lakes. At the Pacific and Atlantic Entrances of the Canal were reported 882 species, while 61 species were reported in the Gatun and Miraflores Locks. With the largest number of species recorded for Gatun lake: Aquatic Insects of medical importance (50 spp.), fresh water fish (33 spp.), marine peripheral fishes (8 spp.), large crustacean that include shrimps and crabs (11 spp), and planktonic crustaceans, specifically copepods (3 spp), and cladoceran (7 spp). At Lake Miraflores the largest number of species recorded included marine fish (14 spp), fresh water fish (24 spp.), large crustaceans that include shrimps and crabs (8 spp), and planktonic crustaceans as Cladocera (6 spp), and Copepods (4 spp) (See Table 2-4 and Section 2.2.2).

Among the 54 freshwater fishes reported for Gatun, 33 species were reported for only on Gatun Lake and other 24 were found in both lakes. Six introduced species were identified in Gatun, which include the Nile tilapia (*Oreochromis niloticus niloticus* Linnaeus, 1758), Flag cichlid (*Mesonauta festivus* Heckel, 1840), and the Peacock Bass (*Cichla ocellaris* Bloch & Schneider, 1801). From the freshwater species mentioned above, 19 primary species were identified which characterizes by its intolerance to salinity and living exclusively in freshwater habitats, from this total 10 species have been reported in Gatun Lake and 9 species were found in both lakes; 12 secondary species were reported which have some grade of tolerance to salinity, from this total 6 species are reported only for Gatun and 6 species were found in both lakes. Almost 23 marine peripheral species were reported in both lakes; from this total 8 are reported for Gatun, 1 specie is common for both lakes was recorded and 14 species in Miraflores Lake. (See Tables 2-4B and 2-4C in Annexes)

Within the marine environment in the Canal Entrances, a total of 333 species have been reported for the Atlantic and 421 species for the Pacific, others 45 species were reported in common to both entrances, including fresh water fishes (24), marine fishes (1), Copepods (6), Cladoceran (7) and large crustaceans (2). From the 8 marine fishes recorded in Gatun 2 are form the Atlantic, 4 were reported at Lake Miraflores. On the other hand, the fish *Achirus mazatlanus* Steindachner, 1869 from the Pacific was reported at Gatun. Other 7 species from the Pacific have been reported in Miraflores that including the Gastropod *Crucibulum spinosum* Sowerby, 1824, the crustacean *Notolopas lamellatus* Stimpson, and the gobies *Ctenogobius sagittula* Günther, 1861, among others.). Among the species reported in both coasts are the bivalve mollusk *Tellina alternata* Say, the Porifera (sponge) *Cliona caribboea* Carter, 1882, the non-segmented worm *Phascolion sp.*, the hydrozoa *Bugula stolonifera* Ryland, the crustacean *Limnoria tripunctata* Menzies, the marine fish *Omobranchus punctatus* (Valenciennes, 1836) that arrived to the Atlantic through the Panama Canal⁹⁴, and the ahermatypic coral *Balanophyllia sp.*, among others (see tables 2-4A, 2-4B, 2-4C, 2-4D, 2-4E).

The total number of animal species associated to the lakes Gatun and Miraflores, and to the Atlantic and Pacific entrance to the Panama Canal amount to approximately 1061 species, according to the literature reviewed. This inventory is mainly made up of Fishes (Marine: 315 ssp., Fresh Water: 62 ssp.), Mollusks (bivalve: 159 ssp.; Gastropods: 85 ssp.), Echinoderms (44 ssp.), Crustacean (126 ssp.), Corals (98 ssp.), and Aquatic Insects (64 ssp.). Smaller numbers of species were present for other groups such as the planktonic Crustaceans - Cladoceran (20 ssp.), and Copepods (28spp) - Polychaete (17 ssp.), Crabs (8), Bryozoan's, Hydrozoans (8 ssp.), Oligochaete, and Brachiopods, among others (Table 2-4).

Table 2-4
Fresh Water and Marine Fauna at the Gatun and Miraflores Lakes, and
At the Atlantic and Pacific Entrances to the Panama Canal

FAUNA	Total Number of Species	G	M	G, M	A	P	A, P	GL	GL,M	ML
Polychaete	17	--	--	--	3	14	--	--	--	--
Oligochaete	1	--	--	1	--	--	--	--	--	--
Mollusks:										
Bivalve	159	1	4	1	20	122	4	4	1	2

FAUNA	Total Number of Species	G	M	G, M	A	P	A, P	GL	GL,M	ML
Gastropods	85	1	3	1	14	45	--	5	--	16
Porifera	4	--	--	--	3	--	1	--	--	--
Sipuncula	1	--	--	--	--	--	1	--	--	--
Chaetognatha	2	--	--	--	1	1	--	--	--	--
Bryozoan	13	--	--	--	6	2	5	--	--	--
Brachiopoda	2	--	--	--	--	2	--	--	--	--
Cephalochordata	1	--	--	--	--	1	--	--	--	--
Echinoderms	44	--	--	--	20	24	--	--	--	--
Poliplacophora (Chiton)	1	--	1	--	--	--	--	--	--	--
Cephalopods	2	--	--	--	--	1	--	--	--	1
Large Crustaceans-Shrimps	126	8	7	2	41	35	3	16	--	14
Large Crustaceans-Crabs	8	3	1		1	2		1		
Planktonic crustaceans:										
Cladoceran	20	7	6	7	--	--	--	--	--	--
Copepods	28	3	4	6	4	4	7	--	--	--
Corals/Anthozoa	98				65	32	1	--	--	--
Corals/Hydrozoa	8				6	2		--	--	--
Marine Fish (Peripherals)	315	8	14	1	147	134	11	--	--	--
Fresh Water Fish	62	33	4	24				1	--	--
Aquatics Insects	64	50	--	--	2	--	12	--	--	--
TOTAL	1061	114	44	43	333	421	45	27	1	33

G: Common species for Gatun Lake; M: Common species for Miraflores Lake; G, M: Species present in both lakes.

A: Common species for the Atlantic entrance of the Panama Canal; P: Common species for the Atlantic entrance of the Panama Canal.

A, P: Species presents for both lakes; GL: Gatun Locks; ML: Miraflores Locks.

Source: Prepared by URS on the basis of the bibliographic information consulted, and the 2004 Biological Inventory, University of Panama - Panama Canal Authority.

2.2 COMPARISON OF PLANT AND ANIMAL SPECIES REPORTED FOR GATUN AND MIRAFLORES LAKES

2.2.1 Flora

2.2.1.1 Phytoplankton

The table 2-5 show the distribution of the species in the different sites while were recorded, in the first columns is presented the number of species, then the totals for Gatun and Miraflores Lakes and in next columns the distribution of each species in the different areas under study with the total, as can seen in the distributional column for Miraflores Lake is empty, this indicate that Miraflores Lake doesn't have species unique to this lake, only inhabit species that had been reported in other localities, it can be observed in the next distributional columns.

The Bacillariophyta or Diatoms were more abundant at Gatun Lake (34), where 22 micro algae species have been reported including taxons such as *Acanthoceras zachariasii* (Brun) Simonsen, *Rhizosolenia longiseta* O. Zacharias, and *Aulacoseira ambigua* (Grunow) Simonsen. Eight of those species were also reported for Miraflores Lake, including: *Aulacoseira ambigua* (Grunow) Simonsen, *A. ambigua* fo. *espiralis*, *Terpsinoe musica* Ehrenberg, *Surirella tenera* Gregory,

among others (Table 2-5). It is important to point out that there are other 7 species, which are being reported for Gatun Lake and on the Pacific side of the Canal, but are not present in Miraflores Lake (Table 2-5). Among those are present *Chaetoceros laciniosus* Schütt, *Fragilaria crotonensis* Kitton, and *Cylindrotheca closterium* (Ehrenberg) Lewin & Reimann. The specie, *Chaetoceros lorenzianum* Grunow was reported for Miraflores Lake and the Pacific entrance and not reported for Gatun Lake. Nine (9) species from the 127 species of diatoms (7.1%) documented to exist in the canal are reported to be able to survive in both marine and freshwater environments, which suggests a limited tolerance of the group to changes in salinity.

The largest diversity of micro algae Chlorophyta (green algae) was observed at Lake Gatun, with a total number of 66 species reported, including taxons such as: *Staurastrum rotula* Nordstedt and *Spondylosium cf. javanicum* (Gutwinski) Groenblad, amongst others (see Table 2-1A of the annex). Of those 66 species, 9 species have also been reported to thrive in Miraflores Lake, namely: *Pediastrum duplex var. asperum* (Braun) Hansgirg, *Pediastrum simplex* Meyen, and *Eudorina elegans* Ehrenberg, among others (Table 2-5). Although a significant number of marine green algae species was reported, including 6 species found on both coasts, none of the species is considered facultative marine/freshwater, suggesting a strong stenohalinity in this group (See Tables 2-9, 2-10, and Table 2-1A in the annex). With respect to the macro algae Chlorophyta, the major diversity was registered in the Atlantic Entrance of the Canal with 24 species including taxons such as *Acetabularia crenulata* J.V. Lamouroux, *Codium isthmocladum* Vickers, *Halimeda copiosa* Goreau & E.A. Graham, amongst others. In the Pacific side only six (6) species were reported that were also reported on the Atlantic side (*Caulerpa sertularioides* (S.G. Gmelin) M. Howe, *Caulerpa microphysa* (Weber-van Bosse) J. Feldmann, and *Caulerpa peltata* J.V. Lamouroux).

Out of the 36 species of micro algae Cyanophyta (blue-green algae) identified, 31 species are found at Gatun Lake. Only 2 of these species have also been reported for Miraflores Lake (Table 2-5), namely *Microcystis aeruginosa* Kuetzing, and *Lyngbya martensiana* Meneghini. This group of algae shows the highest degree of euryhalinity with the highest number of species that are facultative marine/freshwater (17 species), which accounts for 47% of the total number of species in the group. This is consistent with the general observations made by Hutchinson (1967), which indicate an evolutionary euryhalinity in this group based on relatively small genetic changes. As can observe in the Table 2-5 the flora registered in equally present this Miraflores in the rest of the places under study, it does not possess own species but species of wide distribution.

Table 2-5
Distribution of Algae Species Reported at the Gatun and Miraflores Lakes and at the
Entrance at the Caribbean Sea and at the Pacific Ocean to the Panama Canal

Group	Number of Species	Total Gatun	Total Miraflores	G	M	G/M	A	P	A/P	A/G	P/G	P/M	P/G/M	PDML	FW	Ma	FW/Ma
Bacillariohyta	127	34	14	14	--	8	5	77	10	--	7	1	5	--	24	94	9
Chlorophyta	96	66	9	57	--	9	24	-	6	--	--	--	--	--	66	30	--
Cyanophyta	36	33	2	31	--	2	--	--	2	--	--	--	--	1	18	1	17
Dynophyta	28	4	--	4	--	--	--	24	--	--	--	--	--	--	4	24	--
Rhodophyta	15	--	--	--	--	--	15	--	--	--	--	--	--	--	--	15	--

Group	Number of Species	Total Gatun	Total Miraflores	G	M	G/M	A	P	A/P	A/G	P/G	P/M	P/G/M	PDML	FW	Ma	FW/Ma
Chrysophyta	8	6	--	6	--	--	--	2	--	--	--	--	--	--	6	2	--
Phaeophyta	5	--	--	--	--	--	5	--	--	--	--	--	--	--	--	5	--
Euglenophyta	4	4	--	4	--	--	--	--	--	--	--	--	--	--	4	--	--
Xanthophyta	1	--	--	--	--	--	1	--	--	--	--	--	--	--	1	1	--
Total	320	147	25	136	--	16	47	100	18	0	8	1	4	1	123	172	26

G: Lake Gatun; **M:** Lake Miraflores; **A:** Atlantic entrance; **P:** Pacific entrance; **FW:** Fresh Water Species; **Ma:** Marine Species;
Source: Prepared by URS on the basis of the bibliographic information consulted, and the 2004 Biological Inventory by the University of Panama - Panama Canal Authority. (*): One specie was collected in Pedro Miguel Lock.

Out of the 28 species of Dinoflagellates identified in the Canal, only 4 were reported for Lake Gatun (*Ceratium hirundinella* (O.F. Müller) Bergh, *Peridinium umbonatum* F. Stein, and *Dinococcus bicornis* (Woloszynska) Fott). In Miraflores Lake species were not was reported, the rest of the species in this group were reported to the Pacific Entrance.

Only 4 species of Euglenophyta were documented for Lake Gatun: *Euglena* sp. (2 undetermined species), *Phacus cf. pleuronectes* (O.F.M.) Duj Fa, and *Trachelomonas ensifera* fo. *dentifera* Prescott. This group has not been reported in Miraflores Lake or any of the Canal Entrances.

Within the Xanthophyta (yellow-green) only 1 species of algae has been reported for the Atlantic Entrance of the Canal (*Centritractus belanophorus* Lemmermann).

2.2.1.2 Macrophytes

The largest number of marginal macrophytes was reported for Lake Gatun with a total of 25 species. In Miraflores Lake were reported a total of three species, two of this species were registered also in Gatun (*Oriza latifolia* Desv., *Fuirena umbellata* Rottb.). Within this marginal group, there are a number of trees and shrubs associated to the lakes border, especially in Gatun (*Pachira aquatica* Aubl., *Phyllanthus diffusus* Kl., *Brownea macrophylla* Linden).

Within the emergent aquatic macrophytes, there are more species at Gatun Lake (13 ssp.) than in Miraflores Lake (3 ssp.). This is not surprising given the larger size of Lake Gatun and the fact that aquatic macrophytes are in general better represented in freshwater habitat than in brackish or marine environments. Only one species, *Eichhornia azurea* (Sw.) Kunth has been reported in both lakes, which indicates that it may tolerate salinity levels of up to 1.32 ppt, as recorded in Miraflores.

The largest number of floating macrophytes species was also recorded at Gatun Lake (7 ssp.). From these seven species, three (3) were also reported for Miraflores Lake (*Pistia stratiotes* L., and *Eichhornia crassipes* (Mart.) Solms and *Salvinia auriculata* Aubl.). (See Table 2-2A in the annexes).

In relation to the group of submerged macrophytes, the 12 species in the inventory were found to exist at Gatun Lake while two species were reported also to Miraflores Lake (*Hydrilla verticillata* (L. f.) Royle and *Ceratophyllum demersum* L.). Mangrove species has not been

reported in Gatun and Miraflores lakes, they are located at the Pacific and Atlantic Entrances of the Canal.

2.2.2 Fauna

Within the group of **Oligochaeta**, *Branchiura sowerbyi* (Beddard, 1892) was the unique species found in both lakes. None of the 17 species of **Polychaeta** reported for the Canal entrances were present either Lake Gatun or Lake Miraflores. This is not surprising since polychaetes are mostly marine worms, although some species have adapted to brackish or even freshwater and very few are terrestrial.

Two fresh water **Bivalves** species have been reported for Gatun Lake and one fresh water species for Miraflores. Although six were reported for Miraflores, the other 5 are associated to marine habitats, (Table 2-6). One species is common to both lakes, the fresh water Asian clam *Corbicula fluminea* (O. F. Müller, 1774). In addition, the black-striped mussel, *Mytilopsis sallei* Recluz, has been collected at the Miraflores upper lock and the Pedro Miguel Locks. Within the **Gastropods**, 4 species were recorded at Miraflores, and 2 species at Gatun Lake, among them the Central American apple snail *Pomacea flagellata* (Say, 1827). Within the **Mollusca**, the largest number of species was recorded at the Pacific entrance to the Canal (122), while on the Atlantic entrance only 20 species were reported. (see Table 2-4A in the Annex).

As indicated in Table 2-7, 10 species of **large Crustacea** were recorded at Lake Gatun, including species such as *Macrobrachium amazonicum* Heller, *Atya inocous* Herbst, and *A. scabra* Leach, amongst others. On the other hand, 9 species have been reported for Miraflores Lake including typical freshwater species such as: *Macrobrachium digitus* (Abele), *Macrobrachium americanum* (Bate), and *Macrobrachium panamense* (Rathbun). Species common to both Gatun and Miraflores lakes included *Macrobrachium tenellum* (Smith), *Potimirin glabra*, and *Macrobrachium sp.*

A total 16 species were collected from the area around the locks including taxons such as: *Callinectes sapidus* Rathbun, and *Eurypanopeus dissimilis* Benedict & Rathbun, among others.. In addition, forty species were reported on the Atlantic side of the Canal and 37 on the Pacific side. The caridean shrimp *Palaemon pandaliformis* (Stimpson) was reported on the Atlantic side of the Canal, at Gatun and at Pedro Miguel locks, thus suggesting a transoceanic migration towards the Pacific Ocean, which should be verified.

Within the **planktonic Crustacea** the number of freshwater **Cladoceran** reported in the inventories amounted to a total of 20 species, with 7 of those species found in both Gatun Lake and Miraflores Lake, seven species were reported only for Gatun Lake and 6 were reported exclusively for Miraflores Lake. In the second group of predominantly **planktonic Crustacea**, the **Copepods**, 13 freshwater species have been reported as well as another 15 marine species. Out of the total freshwater species reported 6 taxons were reported for both lakes, 3 species were reported only to Gatun Lake, including *Eucyclops agilis* (Koch, 1838), and 4 species were reported only from Miraflores Lake including *Cyclops panamensis* (Marsh). It is important to note that one of the species reported for the Pacific Entrance of the Canal (*Pseudodiaptomus culebreensis* (Marsh)) was also reported from Miraflores Lake.

Aquatic insect are predominantly from terrestrial origin, after developing modifications to survive in freshwater, or to spend a portion of their life cycle in water. While a total of 50 species of aquatic insects have been reported for Lake Gatun, there are no formal reports for aquatic insects in Lake Miraflores. Within the species reported for Gatun Lake there are several members of Culicidae family which are known to transmit human diseases including at least three species of *Mansonia* genus, namely: *M. titillans* (Walker, 1848), *M. leperi* (Boreham), and *M. pseudotitillans* (Theobald) (see Table 2-4D in the Annex).

Based on the reported inventories, the diversity of **freshwater fish** is significantly greater in Lake Gatun (33 spp) than Lake Miraflores (4 spp) (Table 2-6). Other 24 species are present in both lakes. There are five (5) species reported in Miraflores Lake that had not been recorded in Gatun Lake.

According to the ability to the salt tolerance nineteen (19) primary species were identified in Gatun and Miraflores lakes, where 10 species correspond to Gatun (*Brachyhypopomus brevirostris* (Steindachner, 1868), *Astronotus ocellatus* (Agassiz, 1831), *Cyphocharax magdalena* (Steindachner, 1878) and 9 species are found in both lakes (*Astyanax orthodus* (Eigenmann, 1907), *Brycon behreae* (Hildebrand, 1938)). On the other hand 12 secondary species were reported, from this total 6 species are reported only for Gatun (*Synbranchus marmoratus* (Bloch, 1795), *Gambusia nicaraguensis* (Günther, 1866)) and 6 secondary species are found in both lakes (*Aequidens coeruleopunctatus* (Kner & Steindachner, 1863), *Archocentrus panamensis* (Meek & Hildebrand, 1913)). Almost 16 peripheral species were reported for both lakes; from this total 7 are reported for Gatun (*Microphis brachyurus lineatus* (Kaup, 1856), *Awaous tajasica* (Lichtenstein, 1822)) and the rest in both lakes (*Gobiomorus maculatus* (Günther, 1859), *Piabucina panamensis* (Gill, 1877), *Eleotris picta* Kner & Steindachner, 1863).

Regarding the **marine peripheral fishes**, 12 species were reported for Miraflores Lake, and 8 species for Gatun Lake, being within the most outstanding ones: *Elops affinis* (Regan), *Eugerres brevimanus* (Günther), and *Centropomus viridis* (Lockington), among others. The goby - *Parrella lucretiae* (Eigenmann & Eigenmann, 1888), the Peruvian mojarra - *Diapterus peruvianus* (Cuvier, 1830), the yellow-fin mojarra - *Gerres cinereus* (Walbaum, 1792), and the tarpon - *Megalops atlanticus* (Valenciennes) have been reported from both lakes. Gunther⁹⁴ considers that several species of migratory marine fish travel from the Atlantic to the Pacific Ocean through the Canal. Among these species we should mention the gobies - *Barbulifer ceuthoecus* (Jordan & Gilbert, 1884), and *Lophogobius cyprinoides* (Pallas, 1770), and the blennies - *Lupinoblennius dispar* (Herre, 1942), and *Hyleurochilus aequipinnis* (Günther, 1861)

In accordance with Gutierrez (1994), there is a one specie considered a truly aquatic mammal that was introduced in Gatun Lake in 1962, commonly named Manati (*Trichechus manatus*) and can be found in both lakes. Gutierrez also reported other semi aquatic species for Gatun Lake, *Chironectes minimus* (Didelphidae; Marsupialia), *Lutra longicaudis* (Mustelidae; Carnivora), *Hydrochaeris hydrochaeris* (Hydrocharidae; Rodentia) and two little mice's (*Oryzomys couesi* and *O. alfaroi* (Cricetidae).

Table 2-6
Animal Species Reported for Gatun and Miraflores Lakes and at the
Atlantic and Pacific Entrances to the Panama Canal

Main Taxonomic Groups	Number Of Species	G	M	G, M	A	P	A, P	G L	GL,M	ML	D	Ma
Polychaeta	17	--	--	--	3	14	--	--			--	17
Oligochaeta	1	--	--	1	--	--	--	--			1	--
Mollusks:												
Bivalve	159	1	4	1	20	122	4	4	1	2	6	153
Gastropods	85	1	3	1	14	45	--	5	--	16	5	80
Porifera	4	--	--	--	3	--	1	--	--	--	--	4
Sipuncula	1	--	--	--	--	--	1	--	--	--	--	1
Chaetognatha	2	--	--	--	1	1	--	--	--	--	--	2
Bryozoan	13	--	--	--	6	2	5	--	--	--	--	13
Brachiopoda	2	--	--	--	--	2	--	--	--	--	--	2
Cephalocordata	1	--	--	--	--	1	--	--	--	--	--	1
Echinoderms	44	--	--	--	20	24	--	--	--	--	--	44
Poliplacophora (Chiton)	1	--	1	--	--	--	--	--	--	--	--	1
Cephalopods	2	--	--	--	--	1	--	--	--	1	--	2
Large Crustacean/Shrimps	126	8	7	2	41	35	3	16	--	14	17	109
Large Crustacean/Crabs	8	3	1	--	1	2	--	1	--	--	4	4
Planktonic Crustacean									--	--		
Cladocera	20	7	6	7	--	--	--	--	--	--	20	--
Copepods	28	3	4	6	4	4	7	--	--	--	13	15
Aquatic Insects	64	50	--	--	2	--	12	--	--	--	50	14
Corals/Anthozoa	98	--	--	--	65	32	1	--	--	--	--	98
Corals/Hydrozoa	8	--	--	--	6	2	--	--	--	--	--	8
Marine Fish	315	8	14	1	147	134	11	--	--	--	--	315
Fresh Water Fish	62	33	4	24	--	--	--	1	--	--	62	--
TOTAL	1,060	114	44	43	333	421	45	27	1	33	178	882

G: Gatun Lake; M: Miraflores Lake; G, M: Species in common for Gatun and Miraflores Lake; A: Atlantic Entrance; P: Pacific Entrance; A,P: Species in common for the Atlantic and Pacific Entrances; G,A: Species in common for Gatun and the Pacific side. GL: Gatun Locks; ML: Miraflores Locks; GL,M: Species in common in Gatun Locks and Miraflores Lake. M,P: species in common for Miraflores and Pacific side; D: Fresh water species; Ma: Marine species.

Source: Prepared by URS on the basis of the bibliographic information consulted, and the 2004 Biological Inventory, University of Panama - Panama Canal Authority.

Avian inventories for Gatun and Miraflores Lakes were unavailable during the preparation of this document. However, URS developed a list of bird species based on a revision of the book Birds of Panama. A list of 35 species, mostly associated to the Pacific and Atlantic Entrances of the Canal (Table 2-7) was generated. Species identified included migratory species observed in Gatun and Miraflores lakes (*Anas americanum*, *Anas discolor*, *Aythya affinis*, among others), as well as marine species that use the Canal to move from coast to coast (*Phalacrocorax olivaceus*, *Fregata magnificens*). Within the Canal were observed birds how *Podilymbus podiceps*, *Agamia agami*, *Mycteria Americana*. In the case of the reptiles, there are two species of crocodiles reported in the aquatic boundaries of Barro Colorado Island located in Gatun lake (*Caiman crocodilus* and *Crocodylus acutus*), 5 turtles species (*Chelydra acutirostris*, *Rhinoclemmys annulata*, *R. funerea*, *Kinosternon leucostomum* and *Trachemys scripta*), between the iguanids is possible find *Iguana iguana* and *Ctenosaura simili*, the last can been seen in the Atlantic side in some island in Gatun Lake. Among the amphibian species that should inhabits the lake margin in

Gatun and Miraflores are *Bufo marinus*, *Colostethus inguinalis*, *Eleutherodactylus bufoniformis* and *Rana warcschewitschii*, (Rand & Myers in Gentry, 1990)

Table 2-7
Avian Fauna Reported for Gatun and Miraflores Lakes, Including the
Atlantic and Pacific Entrances of the Canal

Family	Species	Locality	Habitat	Common Name
Podicipedidae	<i>Tachybaptus dominicus</i>	A, P	Ma	Least Grebe
Podicipedidae	<i>Podilymbus podiceps</i>	CA	Ma	Pie-billed Grebe
Procellariidae	<i>Calonectris diomedea</i>	A	Ma	
Procellariidae	<i>Puffinus griseus</i>	P	Ma	Sooty Shear water
Procellariidae	<i>Puffinus lherminieri</i>	P	Ma	Audubon Shear water
Hydrobatidae	<i>Oceanitis gracilis</i>	P	Ma	White vented Storm Petrel
Sulidae	<i>Sula dactylatra</i>	A	Ma	
Pelicanidae	<i>Pelecanus occidentalis</i>	P	Ma	Brown Pelican
Phalacrocoracidae	<i>Phalacrocorax oliaeus</i>	A, P	Ma	
Fregatidae	<i>Fregata magnificens</i>	P	Ma	
Ardeidae	<i>Ixobrychus exilis</i>	G	FW	Least Bittern
Ardeidae	<i>Botaurus lentiginosus</i>	A	Ma	American Bittern
Ardeidae	<i>Tigrisoma lineatum</i>	A	Ma	
Ardeidae	<i>Ardea cocoi</i>	G	FW	
Ardeidae	<i>Agamia agami</i>	CA	FW	
Ardeidae	<i>Pilherodius pileatus</i>	G	Fw	
Ardeidae	<i>Nyctanassa violacea</i>	P	Ma	
Ardeidae	<i>Coccharius sp.</i>	A, P	Ma	
Threskiornithidae	<i>Eudocimus albus</i>	P	Ma	White Ibis
Threskiornithidae	<i>Eudocimus ruber</i>	P	Ma	
Threskiornithidae	<i>Plegadis falcinellum</i>	A	Ma	
Threskiornithidae	<i>Ajaia ajaja</i>	A, P	Ma	
Ciconiidae	<i>Mycteria americana</i>	CA	FW, Ma	
Anatidae	<i>Anas discolor</i>	G	FW	Migratory specie
Anatidae	<i>Anas clypeata</i>	PDM	FW	Migratory specie
Anatidae	<i>Anas americanum</i>	M	FW	Migratory specie
Anatidae	<i>Aythya collaris</i>	M	FW	Migratory specie
Anatidae	<i>Aythya affinis</i>	M	FW	Migratory specie
Cathartidae	<i>Cathartes aura</i>	P	Ma	
Accipitridae	<i>Rostrhamus sociabilis</i>	CA	Fw	
Jakanidae	<i>Jacana jacana</i>	G	Fw	
Alcedinidae	<i>Ceryle torquata</i>	CA	Fw	
Alcedinidae	<i>Chloroceryle amazona</i>	G	Fw	
Alcedinidae	<i>Chloroceryle inda</i>	CA	Fw	Scarce population.
Alcedinidae	<i>Chloroceryle aenea</i>	CA	Fw	

G: Lake Gatun; **M:** Lake Miraflores; **A:** Atlantic entrance to the Canal; **P:** Pacific entrance to the Canal; **FW:** Fresh water species; **Ma:** Marine species; **CA:** Canal Area.

2.3 SALINITY TOLERANCE AND SPECIES OF IMPORTANCE

According to Weers²⁸, any increase in salinity would cause the destruction of small unicellular algae, and consequently the Dinoflagellates and Euglenoides of Lake Gatun, such as *Peridinium umbonatum* F. Stein, *Dinococcus bicornis* (Woloszynska) Fott and *Ceratium hirundinella* (O.F.Müller) Bergh, could disappear. This statement is consistent with the fact that none of the groups are represented in the more brackish waters of Lake Miraflores. Furthermore, the same author established that the desmids (Desmidaceae), which are one of the most important groups within the green algae, might disappear if there is a slight increase in salinity. Species in this group include taxons such as, *Spondylosium cf. javanicum* (Gutwinski) Groenblad, *Staurastrum rotula* Nordstedt, *Micrasterias radiosoa* var. *ornata* fo. *elegantor* G.S. West, among others. It should be noted that the referenced articles consider increments of salinity in excess of 1 part per thousand and that a “slight” increase in salinity in the context of these articles may be a substantial increment in the context of the Panama Canal Expansion.

Various groups of algae could be affected by an increase in salinity. These include the Cyanophytes with the families Chroococcaceae (includes the species *Chroococcus dispersus* (Keissler) Lemmermann, and *Chroococcus limneticus* Lemmermann), and Nostocaceae (includes *Rivularia sp.*); the Bacillariophytes that include the families Biddulphiaceae (*Biddulphia sp.*) and Aulacoseiraceae (*Melosira granulata* (Ehrenberg) Ralfs); the Chrysophytes (Dinobryaceae: *Dinobryon bavaricum* Imhof); the Dinophytes (Peridiniaceae: *Peridinium gatunense* Nygaard); and the Euglenophytes (Euglenace: *Phacus cf. pleuronectes* (O.F.M.) Duj Fa). Groups that could invade the lakes include the Cyanophytes (Oscillatoriaceae), Chlorophytes (Cladophoraceae), Bacillariophytes (Bacillariaceae) and Xanthophytes (Table 2-9)

According to Table 2-8 there are 15 species which may tolerate variations in salinity, since these species are found in an environment, such as Gatun Lake where salinity is lower than 0.05 ppt along the navigation channel (0 ppt, at USACE, 2000) and at the same time in waters such as those of Miraflores Lake, which have recorded values ranging between 0.104 and 1.32 ppt (USACE, 2000), thus suggesting that these species may continue to exist in Lake Gatun if there is an increase in salinity up to the levels observed in Miraflores Lake.

According to Pasco³², both species *Pistia stratiotes* L. and *Eichhornia crassipes* (Mart.) Solms. both present a salinity tolerance ranging between 1 and 10 ppt. Other species present at Lake Gatun, such as *Lemna minor* L., *Azolla caroliniana* Willd., and *Salvinia auriculata* Aubl., among others, are also known to have similar ranges of tolerance to changes in salinity. Two marginal macrophytes that are known for their tolerance to salinity (*Fuirena umbellata* Rottb. and *Oriza latifolia* Desv.) were reported for Gatun Lake.

According to Hurlbert⁴⁴, the relative abundance of Cladoceran is affected by an increase in salinity over 0.5‰, while some groups of Copepods, such as the calanoid and cyclopoid copepods, are benefited by an increase in salinity.

Various species of importance have been identified based on the identification of plant and animal species carried out in section 2.1, and the comparison of species (between Miraflores and Gatun) done in section 2.2.

The selection of plant and animal species that could be affected by an increase in salinity levels of Gatun and Miraflores lakes was based on work performed by researchers as part of the Sea Water Pumping Environmental Study. This study evaluated the possible impacts on Lake Gatun biota that would occur if salinity levels would reach 11 – 15 ppt. Another criteria that were used were the capacity of some species to withstand salinity increases, as well as the capacity of species to enter freshwater systems allowing them to invade these habitats. The information was corroborated using literature and databases available on the Internet.

Based on these criteria, four tables were developed, two (2-9 and 2-10 in annex) that include the species of flora and fauna that could be affected, respectively. Tables 2-10 and 2-11 include the species that could invade Gatun and Miraflores lakes.

The animal groups that could be affected include the freshwater mollusks (Thiaridae, Ampullariidae), the cladocerans (Bosminidae), Copepods (Cyclopidae and Diaptomidae). Freshwater fish that could be affected include mostly Characidae. Aquatic insects of epidemiological importance belong to the Culicidae family (Table 2-11, in annexes). Crustaceans (Palaemonidae family) and marine fish (Engraulidae and Eleotridae, among other) and copepods (Acartiidae), present a higher risk of invasion (Table 2-12 in annexes).

**Table 2-8: Algae Recorded at Gatun and Miraflores Lakes and at the
Atlantic and Pacific Entrances to the Panama Canal**

Group	Family	Species	Location	Habitat	Remarks
Blue-green algae	Microcystaceae	<i>Microcystis aeruginosa</i> Kuetzing	G, M	D	
Blue-green algae	Oscillatoriaceae	<i>Lyngbya mertensiana</i> Meneghini	G, M	D	
Blue-green algae	Oscillatoriaceae	<i>Sirocoleum kurzii</i> (Zeller) Gomont	A, P	D, Ma	
Blue-green algae	Phormidiaceae	<i>Porphyrisiphon miniatus</i> (Hauck) Drouet	A, P	Ma	Stenohaline species.
Green algae	Hydrodictyaceae	<i>Pediastrum duplex</i> var. <i>asperum</i> (Braun) Hansgirg	G, M	D	
Green algae	Hydrodictyaceae	<i>Pediastrum simplex</i> Meyen	G, M	D	
Green algae	Hydrodictyaceae	<i>Pediastrum simplex</i> var. <i>duodenarium</i> (Bailey) Rabenhorst	G, M	D	
Green algae	Oedogoniaceae	<i>Oedogonium sp</i>	G, M	D	
Green algae	Volvocaceae	<i>Eudorina elegans</i> Ehrenberg	G, M	D	
Green algae	Desmidiaceae	<i>Staurastrum sp2</i>	G, M	D	
Green algae	Desmidiaceae	<i>Staurastrum sp3</i>	G, M	D	
Green algae	Desmidiaceae	<i>Staurastrum sp5</i>	G, M	D	
Green algae	Cladophoraceae	<i>Rhizoclonium riparium</i> (Roth) Harvey	P, A	Ma	They may invade the Lake due to increase in salinity.
Green algae	Cladophoraceae	<i>Rhizoclonium riparium</i> var. <i>implexum</i> (Dillwyn) Rosenvinge	P, A	Ma	They may invade the Lake due to increase in salinity.
Green algae	Caulerpaceae	<i>Caulerpa microphysa</i> (Weber-van Bosse) J. Feldmann	P, A	Ma	
Green algae	Caulerpaceae	<i>Caulerpa peltata</i> J.V. Lamouroux	P, A	Ma	
Green algae	Caulerpaceae	<i>Caulerpa racemosa</i> (Forsskål) J. Agardh	P, A	Ma	Macroalgae in coral reefs and shelves.
Green algae	Caulerpaceae	<i>Caulerpa sertularioides</i> (S.G. Gmelin) M. Howe	P, A	Ma	Macroalgae in coral reefs and shelves.
Bacillariophyta	Aulacoseiraceae	<i>Aulacoseira ambigua</i> (Grunow) Simonsen V. <i>ambigua</i> fo. <i>espiralis</i>	G, M	D, Ma	
Bacillariophyta	Aulacoseiraceae	<i>Aulacoseira ambigua</i> var. <i>ambigua</i> fo. <i>espiralis</i> (Skuja) Ludwing	G, M	D, Ma	
Bacillariophyta	Biddulphiaceae	<i>Terpsinoe mausica</i> Ehrenberg	G, M	D, Ma	
Bacillariophyta	Eunotiaceae	<i>Eunotia sp</i>	G, M	D, Ma	
Bacillariophyta	Surirellaceae	<i>Surirella tenera</i> Gregory	G, M	D, Ma	
Bacillariophyta	Bacillariaceae	<i>Cylindrotheca closterium</i> Ma (Ehrenberg) Lewin & ReiMaann	P, G	D, Ma	
Bacillariophyta	Chaetocerotaceae	<i>Chaetoceros laciniosus</i> Schütt	P, G	D, Ma	
Bacillariophyta	Coscinodiscaceae	<i>Coscinodiscus spp</i>	P, G	D, Ma	
Bacillariophyta	Fragilariaeae	<i>Fragilaria crotensis</i> Kitton	P, G	D, Ma	
Bacillariophyta	Fragilariaeae	<i>Fragilaria goulardii</i> (Brébisson) Lange-Bertalot	P, G	D, Ma	
Bacillariophyta	Fragilariaeae	<i>Fragilaria sp.</i>	P, G	D	
Bacillariophyta	Fragilariaeae	<i>Fragilaria ulna</i> (Nitzsch) Lange-Bertalot	P, G	D, Ma	

**Table 2-8: Algae Recorded at Gatun and Miraflores Lakes and at the
Atlantic and Pacific Entrances to the Panama Canal**

Group	Family	Species	Location	Habitat	Remarks
Bacillariophyta	Naviculaceae	<i>Navicula sp.</i>	P, G	D	
Bacillariophyta	Chaetocerotaceae	<i>Chaetoceros diversuma</i> Cleve	P, G, MA	D, Ma	
Bacillariophyta	Coscinodiscaceae	<i>Coscinodiscus asteromaphalus</i> Ehrenberg	P, G, MA	D, Ma	
Bacillariophyta	Fragilariaeae	<i>Fragilaria nanana</i> Lange-Bertalot	P, G, MA	D, Ma	
Bacillariophyta	Lithodesmiaceae	<i>Lithodesmaiuma undulatuma</i> Ehrenberg	P, G, MA	D, Ma	
Bacillariophyta	Chaetocerotaceae	<i>Chaetoceros lorenzianum</i> Grunow	P, MA	D, Ma	
Bacillariophyta	Chaetocerotaceae	<i>Bacteriastruma delicatuluma</i> Cleve	P, A	Ma	
Bacillariophyta	Chaetocerotaceae	<i>Chaetoceros coarctatus</i> Lauder	P, A	Ma	
Bacillariophyta	Coscinodiscaceae	<i>Coscinodiscus concinnus</i> W. Smith	P, A	Ma	
Bacillariophyta	Coscinodiscaceae	<i>Coscinodiscus radiatus</i> Ehrenberg	P, A	Ma	
Bacillariophyta	Hemialculaceae	<i>Cerataulina pelagica</i> (Cleve) Hendey	P, A	Ma	
Bacillariophyta	Thalassionemataceae	<i>Thalassionema nitzschiooides</i> Grun	P, A	Ma	
Bacillariophyta	Thallassiosiraceae	<i>Skeletonema costatum</i> (Greville) Cleve	P, A	Ma	
Bacillariophyta	Thallassiosiraceae	<i>Thalassisira sp.</i>	P, A	Ma	
Bacillariophyta	Rhizosoleniaceae	<i>Guinardia flaccida</i> (Castracane) H. Peragallo	P, A	Ma	
Bacillariophyta	Rhizosoleniaceae	<i>Rizosolenia imabrigata</i> Brightwell	P, A	Ma	
DINOPHYTA	Ceratiaceae	<i>Ceratiuma hirundinella</i> (O.F. MAüller) Bergh	G	D	
DINOPHYTA	Peridiniaceae	<i>Peridinium umabonatum</i> F. Stein	G	D	
DINOPHYTA	Phytodiniaceae	<i>Dinococcus bicornis</i> (Woloszynska) Fott	G	D	

G: Lake Gatun; **M:** Lake Miraflores; **A:** Atlantic entrance to the Canal; **P:** Pacific entrance to the Canal; **FW:** Fresh water species; **Ma:** Marine species

3.0 CONCLUSIONS

Based on the identification and comparison of plant and animal species in Lakes Gatun and Miraflores, and taking into account their response to salinity, the following conclusion may be made:

- A total of 136 species of Algae have been reported for Gatun Lake and 25 species for Miraflores Lake, 103 species for the Pacific and 47 for Atlantic side of the Canal.
- More species of algae are reported for Gatun Lake than for Miraflores Lake, being the green algae (66), the blue-green algae (34) and the diatoms (22) the more abundant groups for Gatun Lake. Meanwhile, fifteen species are found in both lakes, 7 species of diatoms were reported for Gatun Lake and the Pacific side of the Canal.
- A total of 9 major groups and 320 species of Algae have been reported in the Panama Canal. The group with more species is the diatoms (127 species), followed by the green algae (96), the blue-green algae (36), the dinoflagellates (28), and the red algae (15).
- A total of 123 species of fresh water algae, 172 marine algae and 26 species that inhabit marine and freshwater environments have been reported.
- Inventories conducted to date reported a total of 95 species of aquatic macrophytes. They have been classified in 4 functional groups, based on their growth and distribution patterns: Marginal (54 ssp.), Emergent (19), Submerged (12), and Floating (10) macrophytes. Reports indicate that Gatun Lake harbors by far the highest number of aquatic macrophyte species with 55 spp. For Lake Miraflores reports suggest the presence of 12 species with 4 of them only present in Miraflores Lake and 9 species that have also been reported for Gatun Lake.
- A total of 11 plant species belonging to the mangrove community were identified, with 4 species reported only for the Atlantic side, and 7 species found in both coasts. One species - *Cassipourea elliptica* (Sw.) Poirer is reported for both coasts as well as for Gatun Lake.
- A total of 1061 species of animals have been reported for the Panama Canal Area. They are distributed in 21 groups, with prevalence of mollusks (244), marine and fresh water fish (377 ssp), Crustacean (182), Antozoa Corals (98), Insects (64) and Echinoderms (44).
- Available information indicates a greater number of species reported for Gatun Lake (114) than for Lake Miraflores (44), while inventories suggest that other 43 species have been found in both lakes. On the other hand, a slightly higher number of species have been reported for the Pacific side of the Canal (421) than for the Atlantic (333). The same inventories report a significantly greater number of marine animal species (882) than freshwater species (178).
- The difference in the quantity of species reported for Gatun Lake and Miraflores Lake may be attributed to the difference in salinity of the two lakes.

- The salinization of Gatun Lake could result in significant changes in plant and animal species, as evidenced by the Miraflores Lake experience. Some authors consider that with any increase in the salinity some micro algae should disappear and between freshwaters fishes its larvae and eggs should be affected, the adult forms can resist any changes in salinity. In the other hand the insect community of medical importance (ex. *Anopheles albimanus*) should be displaced by saline tolerant species forms how *A. aquasalis* that is a much less efficient malaria vector than *A. Albimanus*.
- Although a clear difference may be observed between lakes, there is a degree of uncertainty as to the exact salinity level that would bring about the disappearance of species present in Gatun Lake.
- The species determined to be of “importance” may serve as an indicator of ecosystem changes (including salinity levels), if present or absent during sampling events. This list will be the basis for the Ecological Model to be developed in Task 7 and the Flora and Sampling Plan to be developed as part of Task 4.

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ANNEX 1

Table 2-1 A. Inventory of Phytoplankton and Macroseaweed Associated with the Lakes Gatún, Miraflores, the Atlantic and Pacific Entries of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
CYANOPHYTAS						
45	Oscillatoriales	Oscillatoriaceae	<i>Sirocoleum kurzii</i> (Zeller) Gomont	A, P	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Porphyrsiphon kurzii</i> . In this article.
45	Oscillatoriales	Phormidiaceae	<i>Porphyrisiphon miniatus</i> (Hauck) Drouet	A, P	Ma	Stenohaline specie.
28	Chroococcales	Microcystaceae	<i>Microcystis</i> sp.	G	Fr	
UP/ACP04	Oscillatoriales	Oscillatoriaceae	<i>Lyngbya cf. Lagerheimii</i> (Moebius) Gomont	G	Fr	
68	Oscillatoriales	Oscillatoriaceae	<i>Oscillatoria cf. tenuis</i> Agardh	PDM	Fr	
UP/ACP04	Oscillatoriales	Oscillatoriaceae	<i>Oscillatoria margaritifera</i> (Kützing) Gomont	G	Fr	
UP/ACP04	Chroococcales	Chroococcaceae	<i>Chroococcus dispersus</i> (Keissler) Lemmermann	G	Fr	
UP/ACP04	Chroococcales	Merismopediaceae	<i>Coelosphaerium dubium</i> Grunow	G	Fr	
UP/ACP04	Chroococcales	Chroococcaceae	<i>Chroococcus limneticus</i> Lemmermann	G	Fr	
28	Chroococcales	Chroococcaceae	<i>Chroococcus</i> sp.	G	Fr	
28	Chroococcales	Chroococcaceae	<i>Chroocochloris</i> sp.	G	Fr	
UP/ACP04	Chroococcales	Synechococcaceae	<i>Cyanothecae aeruginosa</i> (Nägeli) Komárek	G	Fr	
UP/ACP04	Oscillatoriales	Phormidiaceae	<i>Trichodesmium lacustre</i> Klebahn	G	Fr	
UP/ACP04	Nostocales	Nostocaceae	<i>Nostoc plantonicum</i> Poretsky & Tschernow	G	Fr	
UP/ACP04	Chroococcales	Entophysalidaceae	<i>Entophysalis lemaniae</i> (C. Agardh) Drouet & Daily	G	Fr	
UP/ACP04	Nostocales	Nostocaceae	<i>Nostoc</i> sp	G	Fr	
28	Nostocales	Nostocaceae	<i>Anabaena</i> sp.	G	Fr	
UP/ACP04	Nostocales	Rivulariaceae	<i>Rivularia</i> sp.	G	Fr	
45	Chroococcales	Chroococcaceae	<i>Aphanothecae elabens</i> (Brébisson) Elenkin	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>coccochloris elabens</i> in this article.
45	Oscillatoriales	Phormidiaceae	<i>Phormidium submembranaceum</i> (Ardissone & Strafforello) Gomont	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Oscillatoria submembranacea</i> in this article.
45	Chroococcales	Chroococcaceae	<i>Aphanothecae stagnina</i> (Sprengel) A. Braun	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Coccochloris stagnina</i> in this article..
45	Chroococcales	Microcystaceae	<i>Microcystis marina</i> (Hansgirg) P.C. Silva	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Anacystis marina</i> in this article..
45	Oscillatoriales	Oscillatoriaceae	<i>Lyngbya lutea</i> (C. Agardh) Areschoug	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Oscillatoria lutea</i> in this article..
45	Oscillatoriales	Schizothrichaceae	<i>Schizothrix arenaria</i> (Berkeley) Gomont	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún
45	Chroococcales	Chroococcaceae	<i>Chroococcus dimidiatus</i> (Kützing) Nägeli	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Anacystis dimidiata</i> in this article.
45	Oscillatoriales	Phormidiaceae	<i>Planktothrix perornata</i> (Skuja) Anagnostidis & Komárek	G	Fr, Ma	<i>Porphyrosiphon notariisi</i> in Humm (45) and this species is found Gatún lake.
45	Oscillatoriales	Schizothrichaceae	<i>Schizothrix mexicana</i> Gomont	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún
45	Chroococcales	Merismopediaceae	<i>Gomphosphaeria aponina</i> Kützing	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún
45	Oscillatoriales	Phormidiaceae	<i>Planktothrix plantonica</i> (Elenkin) Anagnostidis & Komárek	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Microcoleus lyngbyaceus</i> in this article.
45	Oscillatoriales	Schizothrichaceae	<i>Schizothrix tenerrima</i> (Gomont) Drouet	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún
45	Chroococcales	Merismopediaceae	<i>Merismopedia thermalis</i> Kützing	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún. <i>Agmenellum thermale</i> in this article.
45	Oscillatoriales	Pseudanabaenaceae	<i>Spirulina sunsalsa</i> Oersted	G	Fr, Ma	De acuerdo a Humm (45) esta especie está presente en el Lago Gatún. In accordance with Humm (45) this species is present in the Lake Gatún
45	Chroococcales	Chroococcaceae	<i>Johannesbaptista pellucida</i> Taylor & Drouet	G	Fr, Ma	
45	Oscillatoriales	Schizothrichaceae	<i>Schizothrix calcicola</i> (C. Agardh) Gomont	G	Fr, Ma	In accordance with Humm (45) this species is present in the Lake Gatún
UP/ACP04	Chroococcales	Microcystaceae	<i>Microcystis aeruginosa</i> Kuetzing	G, M	Fr	
UP/ACP04	Oscillatriales	Oscillatoriaceae	<i>Lyngbya martensiana</i> Meneghini	G, M	Fr	
TOTAL OF CYANOPHYTA SPECIES				36		
CHLOROPHYTAS						
55	Dasycladales	Polyphysaceae	<i>Acetabularia calyculus</i> J.V. Lamouroux	A	Ma	
78	Dasycladales	Polyphysaceae	<i>Acetabularia crenulata</i> J.V. Lamouroux	A	Ma	Macroseaweed in platforms and coral reefs.
78	Cladophorales	Anadyomenaceae	<i>Anadyomene stellata</i> (Wulff) C. Agardh	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Caulerpaceae	<i>Caulerpa cupressoides</i> (Vahl) C. Agardh	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Caulerpaceae	<i>Caulerpa verticillata</i> J. Agardh	A	Ma	
55	Cladophorales	Cladophoraceae	<i>Chaetomorpha</i> spp.	A	Ma	
55	Bryopsidales	Codiaceae	<i>Codium isthmocladum</i> Vickers	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Codiaceae	<i>Codium repens</i> P.L. Crohan & H.M. Crohan	A	Ma	Macroseaweed in platforms and coral reefs.
55	Siphonocladales	Valoniaceae	<i>Dictyosphaeria cavernosa</i> (Forsskål) Børgesen	A	Ma	Macroseaweed in platforms and coral reefs.
45	Ulvales	Ulvaceae	<i>Enteromorpha lingulata</i> J. Agardh	A	Ma	Macroseaweed in platforms and coral reefs.

Table 2-1 A. Inventory of Phytoplankton and Macroseaweed Associated with the Lakes Gatún, Miraflores, the Atlantic and Pacific Entries of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
45	Ulvales	Gayraliaceae	<i>Gayralia oxyisperma</i> (Kützing) K.L. Vinogradova ex Scagel et al.	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda copiosa</i> Goreau & E.A. Graham	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda discoidea</i> Decaisne	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda gigas</i> W.R. Taylor	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda incrassata</i> (J. Ellis) J.V. Lamouroux	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda opuntia</i> (Linnaeus) J.V. Lamouroux	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Halimedaceae	<i>Halimeda tuna</i> (J. Ellis & Solander) J.V. Lamouroux	A	Ma	Macroseaweed in platforms and coral reefs.
55	Bryopsidales	Udoteaceae	<i>Penicillus capitatus</i> Lamarck	A	Ma	Macroseaweed in platforms and coral reefs.
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium kernerii</i> Stockmayer	A	Ma	
45	Ulvales	Ulvaceae	<i>Ulva compressa</i> Linnaeus	A	Ma	
45	Ulvales	Ulvaceae	<i>Ulva lactuca</i> Linnaeus	A	Ma	
45	Ulvales	Ulvaceae	<i>Ulva paradoxa</i> C. Agardh	A	Ma	
45	Ulvales	Ulvaceae	<i>Ulva prolifera</i> O.F. Müller	A	Ma	
55	Ulvales	Ulvaceae	<i>Ulva spp.</i>	A	Ma	
28	Zygnematales	Desmidiaceae	<i>Arthrodeshmus sp.</i>	G	Fr	
28	Chlorellales	Chlorellaceae	<i>Chlorella sp.</i>	G	Fr	
UP/ACP04	Zygnematales	Closteriaceae	<i>Closterium cf. tortum</i> Griffith	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium cf. contractum</i> Kirchner	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium cf. moniliforme</i> (Turpin) Ralfs	G	Fr	
28	Zygnematales	Desmidiaceae	<i>Cosmarium sp.</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium sp1</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Desmidium baileyi</i> var. <i>baileyi</i> fo. <i>tetragonum</i> Nordstedt	G	Fr	
28	Zygnematales	Desmidiaceae	<i>Desmidium sp.</i>	G	Fr	
UP/ACP04	Chlorococcales	Dictyosphaeriaceae	<i>Dictyosphaerium cf. planctonica</i> Tiffany & Ahls	G	Fr	
UP/ACP04	Chlorococcales	Dictyosphaeriaceae	<i>Dictyosphaerium cf. pulchellum</i> Wood	G	Fr	
28	Chlorococcales	Dictyosphaeriaceae	<i>Dictyosphaerium sp.</i>	G	Fr	Macroseaweed in platforms and coral reefs.
28	Chlorococcales	Scenedesmaceae	<i>Elakothrix sp.</i>	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Volvocales	Volvocaceae	<i>Eudorina sp.</i>	G	Fr	It can invade the Lake for increase of salinity.
28	Chlorococcales	Gloeostyclaceae	<i>Gloeocystis sp.</i>	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Zygnematales	Peniaceae	<i>Gonatozygon cf. aculeatum</i> Hasting	G	Fr	Macroseaweed in platforms and coral reefs.
UP/ACP04	Zygnematales	Peniaceae	<i>Gonatozygon sp</i>	G	Fr	
UP/ACP04	Chlorococcales	Micractiniaceae	<i>Micractinium bornhemiense</i> (W. Conrad) Korshikov	G	Fr	Macroseaweed in platforms and coral reefs.
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias foliacea</i> Bailey	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias laticeps</i> Nordstedt	G, M	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias radiata</i> Hassall	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias radiosia</i> var. <i>ornata</i> fo. <i>elegantior</i> G.S. West	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Zygnematales	Zygnemataceae	<i>Mougeotia sp</i>	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Chlorococcales	Oocystaceae	<i>Oocystis elliptica</i> W. West	G	Fr	It can invade the Lake for increase of salinity.
UP/ACP04	Chlorococcales	Hydrodictyaceae	<i>Pediastrum boryanum</i> var. <i>longicorne</i> Reinsch	G	Fr	Tolerant to falls salinity and to the sweet water.
28	Chlorococcales	Hydrodictyaceae	<i>Pediastrum sp.</i>	G	Fr	
UP/ACP04	Volvocales	Volvocaceae	<i>Pleodorina californica</i> Shaw	G	Fr	
28	Chlorococcales	Scenedesmaceae	<i>Scenedesmus sp.</i>	G	Fr	
UP/ACP04	Chlorococcales	Palmellaceae	<i>Sphaerocystis schroeteri</i> Chodat	G	Fr	
UP/ACP04	Chlorococcales	Palmellaceae	<i>Sphaerocystis sp1</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium cf. javanicum</i> (Gutwinski) Groenblad	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium planum</i> (Wolle) West & West	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium pulchrum</i> (Bailey) Archer	G	Fr	
28	Zygnematales	Desmidiaceae	<i>Stauranthus sp.</i>	G	Fr	
9	Zygnematales	Desmidiaceae	<i>Staurastrum anatinum</i> Cooke & Wills	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. connatum</i> (Lundell) Roy & Bissett	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. subcornutum</i> De Toni	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. wolleanum</i> Butler ex Wolle	G	Fr	
9	Zygnematales	Desmidiaceae	<i>Staurastrum chaetoceros</i> (Schroed.) Smith	G	Fr	
UP/ACP04, 9	Zygnematales	Desmidiaceae	<i>Staurastrum leptocladum</i> Nordstedt	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum rotula</i> Nordstedt	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp.</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp1</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp10</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp11</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp12</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp13</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp4</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp6</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp7</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp8</i>	G	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp9</i>	G	Fr	

Table 2-1 A. Inventory of Phytoplankton and Macroseaweed Associated with the Lakes Gatún, Miraflores, the Atlantic and Pacific Entries of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurodesmus subulatus</i> (Kuetzing) Croasdale	G	Fr	
28	Chlorococcales	Chlorococcaceae	<i>Tetraedron</i> sp.	G	Fr	
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox aureus</i> Ehrenberg	G	Fr	
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox cf. pergibator</i> Powers	G	Fr	
28	Volvocales	Volvocaceae	<i>Volvox cf. tertius</i> Meyer	G	Fr	
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox</i> sp.	G	Fr	
UP/ACP04	Volvocales	Volvocaceae	<i>Eudorina elegans</i> Ehrenberg	G, M	Fr	
UP/ACP04, 45	Oedogoniales	Oedogoniaceae	<i>Oedogonium</i> sp.	G, M	Fr	
UP/ACP04	Chlorococcales	Hydrodictyaceae	<i>Pediastrum duplex</i> var. <i>asperum</i> (Braun) Hansgirg	G, M	Fr	
UP/ACP04	Chlorococcales	Hydrodictyaceae	<i>Pediastrum simplex</i> Meyen	G, M	Fr	
UP/ACP04	Chlorococcales	Hydrodictyaceae	<i>Pediastrum simplex</i> var. <i>duodenarium</i> (Bailey) Rabenhorst	G, M	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum</i> sp2	G, M	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum</i> sp3	G, M	Fr	
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum</i> sp5	G, M	Fr	
78	Bryopsidales	Caulerpaceae	<i>Caulerpa microphysa</i> (Weber-van Bosse) J. Feldmann	P, A	Ma	macroalgae
78	Bryopsidales	Caulerpaceae	<i>Caulerpa peltata</i> J.V. Lamouroux	P, A	Ma	macroalgae
55, 78	Bryopsidales	Caulerpaceae	<i>Caulerpa racemosa</i> (Forsskål) J. Agardh	P, A	Ma	macroalgae
55, 78	Bryopsidales	Caulerpaceae	<i>Caulerpa sertularioides</i> (S.G. Gmelin) M. Howe	P, A	Ma	macroalgae
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium riparium</i> (Roth) Harvey	P, A	Ma	
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium riparium</i> var. <i>implexum</i> (Dillwyn) Rosenvinge	P, A	Ma	
			TOTAL OF GREEN ALGAE SPECIES	97		
BACILLARIOPHYTAS						
43	Acanthales	Fragilariaceae	<i>Fragilaria goulardii</i> (Brébisson) Lange-Bertalot	P, G	Fr, Ma	
UP/ACP04	Aulacoseirales	Acanthocerataceae	<i>Acanthoceras zachariasii</i> (Brun) Simonsen	G	Fr	
UP/ACP04	Aulacoseirales	Aulacoseiraceae	<i>Aulacoseira granulata</i> (Ehr.) Simonsen	G, M	Fr	
UP/ACP04	Aulacoseirales	Cocconeidiaceae	<i>Cocconeis neodiminuta</i> Krammer	A	Ma	
UP/ACP04	Aulacoseirales	Lithodesmiaceae	<i>Lithodesmium undulatum</i> Ehrenberg	P, G, M	Fr, Ma	
UP/ACP04	Bacillariales	Aulacoseiraceae	<i>Melosira granulata</i> (Ehrenberg) Ralfs	G	Fr	
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia behreli</i> Hustedt	P	Ma	
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia</i> sp1	P	Ma	
UP/ACP04	Bacillariales	Bacillariaceae	<i>Pseudo-nitzschia pungens</i> (Grunow) Hasle fo. <i>pungens</i> (Grunow) Hasle	P	Ma	
UP/ACP04	Bacillariales	Chaetocerotaceae	<i>Bacteriastrum cf. mediterraneum</i> Pavillard	P	Ma	
UP/ACP04	Bacillariales	Eunotiaceae	<i>Eunota</i> sp	G, M	Fr, Ma	
UP/ACP04	Bacillariales	Hemidiscaceae	<i>Actinocyclus</i> sp	G, M	Fr	
UP/ACP04	Bacillariales	Hyalodiscaceae	<i>Melosira cf. lineata</i> (Dillwyn) Agardh	G	Fr	
UP/ACP04	Bacillariales	Licmophoraceae	<i>Licmophora lyngbyei</i> (Kützing) Grunow ex Van Heurck	A	Ma	
UP/ACP04	Bacillariales	Stephanodiscaceae	<i>Cyclotella</i> sp.	G	Fr	
UP/ACP04	Biddulphiales	Attheyaceae	<i>Attheya</i> sp.	G	Fr	
43, UP/ACP04	Biddulphiales	Chaetocerotaceae	<i>Bacteriastrum delicatulum</i> Cleve	P	Ma	
UP/ACP04	Biddulphiales	Chaetocerotaceae	<i>Chaetoceros anastomosans</i> Grunow en Van Heurck	P	Ma	
UP/ACP04	Biddulphiales	Fragilariaceae	<i>Synedra acus</i> Kützing	G	Fr	
UP/ACP04	Chaetocerotales	Aulacoseiraceae	<i>Aulacoseira cf. ambigua</i> (Grunow) Simonsen	G, M	Fr	
43, UP/ACP04	Chaetocerotales	Biddulphiaceae	<i>Biddulphia</i> sp	G, M	Fr	
28	Chaetocerotales	Biddulphiaceae	<i>Terpsinoë musica</i> Ehrenberg	G, M	Fr, Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros cf. densus</i> Cleve	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros costatus</i> Pavillard	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros decipiens</i> Cleve	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros didymus</i> var. <i>didymus</i> Ehrenberg	P	Ma	
43, UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros lorenzianum</i> Grunow	P, M	Fr, Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros pelagicum</i> Cleve	P	Ma	
43, UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros pseudocurvisetus</i> Mangin	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros radicans</i> Schütt	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros rostratus</i> Lauder	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros sociale</i> Lauder	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros</i> sp1	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros tortissimum</i> Gran	P	Ma	
UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros whigamii</i> Brightwell	P	Ma	
43, UP/ACP04	Chaetocerotales	Chaetocerotaceae	<i>Chaetoceros willei</i> Gran	P	Ma	
UP/ACP04	Chaetocerotales	Coscinodiscaceae	<i>Coscinodiscus granii</i> Gough	P	Ma	
UP/ACP04	Chaetocerotales	Coscinodiscaceae	<i>Coscinodiscus oculus iridis</i> Ehrenberg	P	Ma	
UP/ACP04	Chaetocerotales	Entomoneidaceae	<i>Entomoneis alata</i> (Ehrenberg) Ehrenberg	P	Ma	
UP/ACP04	Chaetocerotales	Fragilariaceae	<i>Asterionellopsis glacialis</i> (F. Castracane) F.E. Round	P	Ma	
UP/ACP04	Chaetocerotales	Fragilariaceae	<i>Synedra goulardii</i> Brébison	P	Ma	
UP/ACP04	Chaetocerotales	Hemiaulaceae	<i>Eucampia zooidiacus</i> Ehrenberg	P	Ma	
UP/ACP04	Chaetocerotales	Hemiaulaceae	<i>Hemiallus hauckii</i> Grun	P	Ma	

Table 2-1 A. Inventory of Phytoplankton and Macroseaweed Associated with the Lakes Gatún, Miraflores, the Atlantic and Pacific Entries of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
UP/ACP04	Chaetocerotales	Hemiaulaceae	<i>Hemiaulus membranaceus</i> Cleve	P	Ma	
UP/ACP04	Chaetocerotales	Hemiaulaceae	<i>Hemiaulus sinensis</i> Grev.	P	Ma	
UP/ACP04	Chaetocerotales	Leptocylindraceae	<i>Lectocylindrus danicus</i> Cleve	P	Ma	
UP/ACP04	Chaetocerotales	Licmophoraceae	<i>Licmophora</i> sp	P	Ma	
UP/ACP04	Chaetocerotales	Lithodesmiaceae	<i>Ditylum brightwellii</i> (T. West) Grunow	P	Ma	
UP/ACP04	Chaetocerotales	Naviculaceae	<i>Meuniera membranacea</i> (Cleve) P. C. Silva	P	Ma	
UP/ACP04	Chaetocerotales	Paraliaceae	<i>Paralia sulcata</i> (Ehrenberg) Cleve	P	Ma	
43	Chaetocerotales	Rhizosoleniaceae	<i>Proboscia alata</i> (Brightwell) Sündstrom	A	Ma	
UP/ACP04	Chaetocerotales	Rhizosoleniaceae	<i>Rhizosolenia longiseta</i> O. Zacharias	G	Fr	
UP/ACP04	Chaetocerotales	Thalassionemataceae	<i>Thalassiothrix longissima</i> Cleve & Grunow	A	Ma	
UP/ACP04	Coscinodiscales	Hemipeltaceae	<i>Actinptychus senarius</i> (Ehrenberg) Ehrenberg	P	Ma	
UP/ACP04	Coscinodiscales	Lauderiaceae	<i>Lauderia annulata</i> Cleve	P	Ma	
UP/ACP04	Coscinodiscales	Fragilariaceae	<i>Asterionella formosa</i> Hassall	G	Fr	
43, UP/ACP04	Coscinodiscales	Hyalodiscaceae	<i>Hyalodiscus</i> sp.	G	Fr	
43	Coscinodiscales	Pleurosigmataceae	<i>Pleurosigma</i> sp.	P	Ma	
UP/ACP04	Coscinodiscales	Rhizosoleniaceae	<i>Guinardia striata</i> (Stolterfoth) Hasle	P	Ma	
UP/ACP04	Coscinodiscales	Rhizosoleniaceae	<i>Neocalyptrella robusta</i> Hernández - Becerril & Meave del Castillo	P	Ma	
43, UP/ACP04	Coscinodiscales	Stephanodiscaceae	<i>Cyclotella stelligera</i> (Cleve & Grunow) Van Heurck	G	Fr	
UP/ACP04	Eutoniales	Fragilariaceae	<i>Synedra</i> sp.	G	Fr	
UP/ACP04	Fragilariales	Bacillariaceae	<i>Nitzschia lorenziana</i> var. <i>incerta</i> Grunow	P	Ma	
UP/ACP04	Fragilariales	Bacillariaceae	<i>Nitzschia sigma</i> (Kützing) W. Smith	P	Ma	
UP/ACP04	Fragilariales	Bacillariaceae	<i>Pleurosigma naviculaceum</i> Brébisson	P	Ma	
UP/ACP04	Fragilariales	Bacillariaceae	<i>Pleurosigma normanii</i> Ralfs	P	Ma	
UP/ACP04	Fragilariales	Biddulphiaceae	<i>Biddulphia biddulphiana</i> (J.E. Smith) Boyer	P	Ma	
28	Fragilariales	Biddulphiaceae	<i>Helicothea tamesis</i> (Shrubsole) Ricard	P	Ma	
UP/ACP04	Fragilariales	Rhizosoleniaceae	<i>Dactyliosolen fragilissimus</i> (Bergon) G.R. Hasle	G	Fr	
UP/ACP04	Fragilariales	Rhizosoleniaceae	<i>Pseudosolenia calcar-avis</i> (Schultze) Sundström	P	Ma	
UP/ACP04	Fragilariales	Rhizosoleniaceae	<i>Rhizosolenia acuminata</i> (H. Peragallo) H. Peragallo	P	Ma	
28, 43	Fragilariales	Striatellaceae	<i>Grammatophora angulosa</i> Ehrenberg	A	Ma	
UP/ACP04	Hemiaulales	Rhizosoleniaceae	<i>Rhizosolenia bergenii</i> H. Pérez	P	Ma	
UP/ACP04	Hemiaulales	Rhizosoleniaceae	<i>Rhizosolenia hyalina</i> Ostenfeld	P	Ma	
43, UP/ACP04	Hemiaulales	Rhizosoleniaceae	<i>Rhizosolenia pungens</i> Cleve-Euler	P	Ma	
UP/ACP04	Hemiaulales	Rhizosoleniaceae	<i>Rhizosolenia setigera</i> Brightwell	P	Ma	
UP/ACP04	Hemiaulales	Rhizosoleniaceae	<i>Rhizosolenia striata</i> Greville	P	Ma	
UP/ACP04	Hemiaulales	Surirellaceae	<i>Surirella cf. tenera</i> Gregory	G, M	Fr, Ma	
43, UP/ACP04	Licmophorales	Fragilariaceae	<i>Fragilaria ulna</i> (Nitzsch) Lange-Bertalot	P, G	Fr, Ma	
UP/ACP04	Licmophorales	Rhizosoleniaceae	<i>Rhizosolenia styliformis</i> Brightwell	P	Ma	
UP/ACP04	Lithodesmidales	Aulacoseiraceae	<i>Aulacoseira ambigua</i> var. <i>ambigua</i> fo. <i>espiralis</i> (Skuja) Ludwig	G, M	Fr, Ma	
UP/ACP04	Lithodesmidales	Stephanopyxidaceae	<i>Stephanopyxis turris</i> (Grev. And Arn.) Ralfs	P	Ma	
UP/ACP04	Meloseirales	Chaetocerotaceae	<i>Bacteriathrum hyalinum</i> Lauder	P	Ma	
UP/ACP04	Meloseirales	Chaetocerotaceae	<i>Chaetoceros affinis</i> Lauder	P	Ma	
UP/ACP04	Meloseirales	Striatellaceae	<i>Grammatophora</i> sp.	P	Ma	
43, UP/ACP04	Naviculales	Catenulaceae	<i>Amphora</i> sp	G	Fr	
UP/ACP04	Naviculales	Surirellaceae	<i>Petrodictyon gemma</i> (Ehr.) D. G. Mann en Round et al., 1990	P	Ma	
43	Naviculales	Surirellaceae	<i>Surirella fastuosa</i> Ehrenberg	P	Ma	
UP/ACP04	Paraliales	Thalassionemataceae	<i>Thalassionema frauenfeldii</i> (Grunow) Hallegraeff	P	Ma	
43, UP/ACP04	Rhizosoleniales	Bacillariaceae	<i>Nitzschia cf. ventricosa</i> Kitton	P	Ma	
43, UP/ACP04	Rhizosoleniales	Bacillariaceae	<i>Pleurosigma cf. angulatum</i> (Quekett) Wm. Smith	P	Ma	
43, UP/ACP04	Rhizosoleniales	Chaetocerotaceae	<i>Bacteriastrum delicatulum</i> Cleve	P, A	Ma	
UP/ACP04	Rhizosoleniales	Chaetocerotaceae	<i>Chaetoceros coarctatus</i> Lauder	P, A	Ma	
UP/ACP04	Rhizosoleniales	Chaetocerotaceae	<i>Chaetoceros breve</i> Schütt	P	Ma	
UP/ACP04	Rhizosoleniales	Chaetocerotaceae	<i>Chaetoceros contortum</i> Schütt	P	Ma	
28	Rhizosoleniales	Chaetocerotaceae	<i>Chaetoceros curvisetum</i> Cleve	P	Ma	
43	Rhizosoleniales	Chaetocerotaceae	<i>Chaetoceros diversum</i> Cleve	P, G, M	Fr, Ma	
UP/ACP04	Rhizosoleniales	Coscinodiscaceae	<i>Coscinodiscus concinnus</i> W. Smith	P, A	Ma	
UP/ACP04	Rhizosoleniales	Thalassionemataceae	<i>Lioloma pacificum</i> (E. Cupp) G.R. Hasle	P	Ma	
UP/ACP04	Rhizosoleniales	Thalassiosiraceae	<i>Planktoniella muriformis</i> (Loeblich, Wight y Darley) Round	P	Ma	
UP/ACP04	Rhizosoleniales	Thalassiosiraceae	<i>Thalassiosira eccentrica</i> (Ehr.) Cleve	P	Ma	
UP/ACP04	Rhizosoleniales	Thalassiosiraceae	<i>Thalassiosira leptopus</i> (Grunow ex Van Heurck) Hasle & G. Fryxell	P	Ma	
UP/ACP04	Rhizosoleniales	Triceratiaceae	<i>Odontella mobilis</i> (Bailey) Grunow	P	Ma	
UP/ACP04	Rhizosoleniales	Triceratiaceae	<i>Odontella regia</i> C. A. Agardh	P	Ma	
UP/ACP04	Rhizosoleniales	Triceratiaceae	<i>Odontella sinensis</i> (Griville) Grunow	P	Ma	
43, UP/ACP04	Striatellales	Coscinodiscaceae	<i>Coscinodiscus radiatus</i> Ehrenberg	P, A	Ma	
UP/ACP04	Striatellales	Coscinodiscaceae	<i>Staurastrum</i> sp5	P, G, M	Fr, Ma	
UP/ACP04	Surirellales	Hemiaulaceae	<i>Cerataulina pelagica</i> (Cleve) Hendey	P, A	Ma	
UP/ACP04	Surirellales	Rhizosoleniaceae	<i>Guinardia flaccida</i> (Castracane) H. Peragallo	P, A	Ma	

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
43	Suriellales	Rhizosoleniaceae	<i>Rhizosolenia imbricata</i> Brightwell	P, A	Ma	
UP/ACP04	Suriellales	Rhizosoleniaceae	<i>Rhizosolenia sp.</i>	G	Fr	
43, UP/ACP04	Thalassionematales	Bellerocheaceae	<i>Neoestreptotheca subindica</i> von Stosch	P	Ma	
28	Thalassionematales	Chaetocerotaceae	<i>Chaetoceros denticulatus</i> fo. <i>angusta</i> Hustedt	P	Ma	
28	Thalassionematales	Chaetocerotaceae	<i>Chaetoceros didymus</i> var. <i>protuberans</i> (Lauder) Gran y Yendo	P	Ma	
43, UP/ACP04	Thalassionematales	Fragilariaeace	<i>Fragilaria nanana</i> Lange-Bertalot	P, G, M	Fr, Ma	
UP/ACP04	Thalassionematales	Thalassionemataceae	<i>Thalassionema nitzschioides</i> Grun	P, A	Ma	
UP/ACP04	Thalassiphysales	Chaetocerotaceae	<i>Chaetoceros peruvianus</i> Brightwell	P	Ma	
UP/ACP04	Thalassiphysales	Thalassiosiraceae	<i>Skeletonema costatum</i> (Greville) Cleve	P, A	Ma	
43	Thalassiosira	Bacillariaceae	<i>Cylindrotheca closterium</i> (Ehrenberg) Lewin & Reimann	P, G	Fr, Ma	
43, UP/ACP04	Thalassiosira	Chaetocerotaceae	<i>Bacterialrum furcatum</i> Shadolt	P	Ma	
43, UP/ACP04	Thalassiosira	Chaetocerotaceae	<i>Chaaetoceros debile</i> Cleve	P	Ma	
UP/ACP04	Thalassiosira	Fragilariaeace	<i>Fragilaria sp.</i>	P, G	Fr, Ma	
43, UP/ACP04	Thalassiosira	Naviculaceae	<i>Navicula sp.</i>	P, G	Fr, Ma	
UP/ACP04	Thalassiosira	Thalassiosiraceae	<i>Thalassisira sp.</i>	P, A	Ma	
43, UP/ACP04	Triceratiales	Chaetocerotaceae	<i>Chaetoceros laciniosus</i> Schütt	P, G	Fr, Ma	
UP/ACP04	Triceratiales	Coscinodiscaceae	<i>Coscinodiscus sp.</i>	P, G, M	Fr, Ma	
UP/ACP04	Triceratiales	Fragilariaeace	<i>Fragilaria crotonensis</i> Kitton	P, G	Fr, Ma	
			TOTAL OF DIATOMS SPECIES	127		
CHRYSTOPHYTAS						
28	Chromulinales	Dinobryaceae	<i>Chrysococcus sp.</i>	G	Fr	
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon bavaricum</i> Imhof	G	Fr	These species occur abundantly and characterize clear water lakes in temperate regions worldwide
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon cf. sertularia</i> Ehrenberg	G	Fr	Dinobryon species are highly phototrophic, and their predation on bacteria can play a significant role in the limnetic food web (Veen, 1991). In this way Dinobryon covers most of its P-requirements and can thus compete in phosphorus-poor waters
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon cf. sociale</i> Ehrenberg	G	Fr	
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon sp.</i>	G	Fr	
43	Dictyochales	Dictyochaceae	<i>Dictyocha fibula</i> Ehrenberg	P	Ma	
43	Dictyochales	Dictyochaceae	<i>Distephanus speculum</i> (Ehrenberg) Haeckel	P	Ma	
UP/ACP04	Mischoccales	Centrictactaceae	<i>Centrictactus belanophorus</i> Lemmermann	G	Fr	
			TOTAL OF CHRYSTOPHYTAS SPECIES	8		
RHODOPHYTAS						
55	Ceramiales	Ceramiaceae	<i>Ceramium spp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
55	Ceramiales	Ceramiaceae	<i>Spyridia filamentosa</i> (Wulfen) Harvey	A	Ma	Coral seaweed incrusted in platform and coral reefs.
55	Ceramiales	Rhodomelaceae	<i>Acanthophora spicifera</i> (M. Vahl) Børgesen	A	Ma	Macroseaweed in platforms and coral reefs.
55	Ceramiales	Rhodomelaceae	<i>Laurencia papillosa</i> (C. Agardh) Greville	A	Ma	Macroseaweed in platforms and coral reefs.
55	Corallinales	Corallinaceae	<i>Amphiroa spp.</i>	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Corallinales	Corallinaceae	<i>Lithophyllum sp.</i>	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Corallinales	Corallinaceae	<i>Titanoderma sp.</i>	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Corallinales	Corallinaceae	<i>Porolithon pachydermum</i> (Foslie) Foslie	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Corallinales	Corallinaceae	<i>Hydrolithon boergesenii</i> (Foslie) Foslie	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Corallinales	Sporolithaceae	<i>Sporolithon sp.</i>	A	Ma	Coral seaweed incrusted in platform and coral reefs
55	Gelidiales	Gelidiellaceae	<i>Gelidiella acerosa</i> (Forsskål) Feldmann & G. Hamel	A	Ma	Macroseaweed in platforms and coral reefs.
55	Gelidiales	Hypnaceae	<i>Hypnea musciformis</i> (Wulfen) J.V. Lamouroux	A	Ma	Macroseaweed in platforms and coral reefs.
55	Gigartinales	Hypnaceae	<i>Hypnea spinella</i> (C. Agardh) Kützing	A	Ma	Macroseaweed in platforms and coral reefs.
55	Gigartinales	Hypnaceae	<i>Hypnea sp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
55	Gracilariales	Gracilariaeace	<i>Gracilaria spp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
			TOTAL OF RED ALGAE SPECIES	15	15	
PHAEOPHYTAS						
55	Dictyotales	Dictyotaceae	<i>Dictyota sp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
55	Dictyotales	Dictyotaceae	<i>Dictyopteris sp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
55	Dictyotales	Dictyotaceae	<i>Lobophora variegata</i> (Lamouroux) Womersley ex Oliveira	A	Ma	Macroseaweed in platforms and coral reefs.
55	Ectocarpales	Acinetosporaceae	<i>Hincksia mitchelliae</i> (Harvey) P.C. Silva	A	Ma	Possible invader of the Lake Gatún.
55	Fucales	Sargassaceae	<i>Sargassum spp.</i>	A	Ma	Macroseaweed in platforms and coral reefs.
			TOTAL OF BROWN ALGAE SPECIES	5	5	
DINOPHYTAS						
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium hirundinella</i> (O.F. Müller) Bergh	G	Fr	
28	Peridiniales	Peridiniaceae	<i>Peridinium umbonatum</i> F. Stein	G	Fr	
UP/ACP04	Phytodiniales	Phytodiniaceae	<i>Dinococcus bicornis</i> (Woloszynska) Fott	G	Fr	
UP/ACP04	Dinophysiales	Amphisoleniaceae	<i>Amphisolenia bidentata</i> Schröder	P	Ma	
UP/ACP04	Dinophysiales	Dinophysiaceae	<i>Dinophysis caudata</i> Stein	P	Ma	
UP/ACP04	Dinophysiales	Dinophysiaceae	<i>Ornithocercus steini</i> Schütt	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium candelabrum</i> (Ehrenberg) Stein	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium furca</i> (Ehrenberg) Claparède & Lachmann	P	Ma	

Table 2-1 A. Inventory of Phytoplankton and Macroseaweed Associated with the Lakes Gatún, Miraflores, the Atlantic and Pacific Entries of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium fusus</i> (Ehrenberg) Dujardin	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium horridum</i> Gran	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium karstenii</i> Pavillard	P	Ma	
43, UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium pentagonum</i> Gourret	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium trichoceros</i> (Ehrenberg) Kofoid	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium tripos</i> (O. F. Müller) Nitzsch	P	Ma	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium tripos</i> fo. <i>semipulchellum</i> Jørgensen	P	Ma	
UP/ACP04	Noctilucales	Noctilucaceae	<i>Noctiluca scintillans</i> (Macartney) Ehrenberg	P	Ma	
UP/ACP04	Peridiniales	Oxytoxaceae	<i>Oxytoxum</i> sp	P	Ma	
9	Peridiniales	Peridiniaceae	<i>Peridinium gatunense</i> Nygaard	G	Fr	
UP/ACP04	Peridiniales	Peridiniaceae	<i>Peridinium pendunculatus</i> Schütt	P	Ma	
UP/ACP04	Peridiniales	Peridiniaceae	<i>Peridinium</i> sp1	P	Ma	
UP/ACP04	Peridiniales	Peridiniaceae	<i>Peridinium</i> sp3	P	Ma	
UP/ACP04	Peridiniales	Protoperidiniaceae	<i>Protoperidinium granii</i> (Ostenfeld) Balech	P	Ma	
UP/ACP04	Peridiniales	Protoperidiniaceae	<i>Protoperidinium crassipes</i> (Kofoid) Balech	P	Ma	
UP/ACP04	Peridiniales	Protoperidiniaceae	<i>Protoperidinium oceanicum</i> (VanHöffen) Balech	P	Ma	
UP/ACP04	Prorocentrales	Prorocentraceae	<i>Prorocentrum gracile</i> Schütt	P	Ma	
UP/ACP04	Prorocentrales	Prorocentraceae	<i>Prorocentrum micans</i> Ehrenberg	P	Ma	
UP/ACP04	Pyrocystales	Pyrocystaceae	<i>Pyrocystis fusiformis</i> Wyville - Thomson & Blackman	P	Ma	
UP/ACP04	Pyrocystales	Pyrocystaceae	<i>Pyrophaeus horologium</i> Stein	P	Ma	
			TOTAL OF DINOFLAGELLATE SPECIES	28		
EUGLENOPHYTA						
UP/ACP04		Euglenaceae	<i>Euglena</i> sp	G	Fr	
UP/ACP04		Euglenaceae	<i>Euglena</i> sp1	G	Fr	
UP/ACP04		Euglenaceae	<i>Phacus cf. pleuronectes</i> (O.F.M.) Duj Fa	G	Fr	
UP/ACP04		Euglenaceae	<i>Trachelomonas ensifera</i> fo. <i>dentifera</i> Prescott	G	Fr	
			TOTAL OF EUGLENOPHYTA SPECIES	4		
XANTHOPHYTA (Algas amarillo-verdosas)						
45	Vaucheriales	Vaucheriaceae	<i>Vaucheria dichotoma</i> (Linnaeus) Martius	A	Ma	Possible invader of the Lake Gatún.
			TOTAL OF YELLOW GREEN ALGAE SPECIES	1		

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= Gatun Lake; GL: Gatun Locks

M= Miraflores Lake; PDM= Pedro Miguel Locks; ML: Miraflores Locks

Fr=Freshwater; Ma=Marine

UP/ACP04: Biological Inventory raised by the Universidad de Panamá to the Panama Canal in 2004.

Table 2-2 A. Aquatic Plants Reported in the Lakes Gatún, Miraflores, Atlantic and Pacific Entries of the Panama Canal.

SOURCE	FAMILY	SPECIE	LOCALITY	COMMENTS
EMERGENT				
25, 32	Apiaceae	<i>Hydrocotyle umbellata</i> L.	A, P	
51	Typhaceae	<i>Typha</i> sp.	A, P	With Salinity tolerance. Inhabit in shallow waters.
32	Alismataceae	<i>Sagittaria</i> spp.	G	Arrowhead.
51	Apiaceae	<i>Hydrocotyle</i> sp.	G	
51	Cyperaceae	<i>Eleocharis elegans</i> (Kunth) Roemer & J.A. Schultes	G	
51	Juncaceae	<i>Juncus</i> sp.	G	Narrow-leaf cat-tail.
51, 32	Marsiliaceae	<i>Marsilea polycarpa</i> Hook. & Grev.	G	
51	Menyanthaceae	<i>Nymphoides humboldtiana</i> (Kunth) Kuntze	G	
32	Nymphaeaceae	<i>Nymphaea ampla</i> (Salisb.) DC.	G	dotleaf waterlily
51	Nymphaeaceae	<i>Nymphaea</i> sp.	G	
51	Onagraceae	<i>Ludwigia repens</i> J.R. Forst.	G	
51	Onagraceae	<i>Ludwigia sedioides</i> (HBK) Hara	G	
32	Polygonaceae	<i>Polygonum hydropiperoides</i> Michx.	G	Swamp smartweed.
32	Pontederiaceae	<i>Pontederia rotundifolia</i> L. f.	G	
25, 32	Typhaceae	<i>Typha angustifolia</i> L.	G	Narrow-leaf cat-tail.
51, 32	Pontederiaceae	<i>Eichhornia azurea</i> (Sw.) Kunth	G, M	
32	Cyperaceae	<i>Eleocharis</i> sp.	M	
32	Menyanthaceae	<i>Nymphoides</i> sp.	M	
32	Polygonaceae	<i>Polygonum acuminatum</i> Kunth	M	Tapertip smartweed.
TOTAL OF EMERGENT SPECIES			18	
FLOATING				
32	Azollaceae	<i>Azolla caroliniana</i> Willd.	G/M	Carolina mosquitofern. Present salinity tolerance between 1 to 14 ppt (32)
51	Azollaceae	<i>Azolla</i> sp.	G	
51, 32	Lemnaceae	<i>Lemna minor</i> L.	G	Common duckweed. Present salinity tolerance between 1 to 17 ppt (32). Common Duckweed
32	Lemnaceae	<i>Lemna minuta</i> Kunth	G	Least duckweed.
32	Lemnaceae	<i>Spirodela punctata</i> (G.F.W. Mey.) C.H. Thompson	G	Dotted duckmeat.
51	Parkeriaceae	<i>Ceratopteris pteridoides</i> (Hook.) Hieron.	G	
32	Salviniaceae	<i>Salvinia</i> sp.	G	
51, 32	Araceae	<i>Pistia stratiotes</i> L.	G, M, PDML	Tropical duckweed. Present salinity tolerance between 1 to 7 ppt(32)
51, 32	Pontederiaceae	<i>Eichhornia crassipes</i> (Mart.) Solms	G, M, PDML	Present salinity tolerance between 1 to 11 ppt(32). Common water hyacinth
51	Salviniaceae	<i>Salvinia auriculata</i> Aubl.	M/G	Eared watermoss. Present salinity tolerance between 1 to 13 ppt (32).

Table 2-2 A. Aquatic Plants Reported in the Lakes Gatún, Miraflores, Atlantic and Pacific Entries of the Panama Canal.

SOURCE	FAMILY	SPECIE	LOCALITY	COMMENTS
		TOTAL FLOATING SPECIES		10
MARGINAL				
25	Apocynaceae	<i>Rhabdadenia paludosa</i> (M. Vahl) Miers	A	Salt tolerant specie.
25	Arecaceae	<i>Manicaria saccifera</i> Gaertn.	A	Swamps near to the Atlantic coast.
25	Cyperaceae	<i>Hypolytrum longifolium</i> subsp. <i>nicaraguense</i> (Liebm.) T. Koyama	A	Swamps near to the Atlantic coast.
25	Liliaceae	<i>Crinum longiflorum</i> Herb.	A	Swamps near to the Atlantic coast.
25	Malpighiaceae	<i>Brachypteryx ovata</i> (Cav.) Small	A	
25	Malvaceae	<i>Pavonia preslii</i> Standl.	A	
51, 25	Cyperaceae	<i>Cladium jamaicense</i> Crantz	A	Salt tolerance specie.
25	Hydrophyllaceae	<i>Hydrolea spinosa</i> L.	A, P	Salt tolerant.
25	Aizoaceae	<i>Sesuvium portulacastrum</i> (L.) L.	A, P	In tidal flats in both coasts. Salt tolerant.
25	Bignoniaceae	<i>Enallagma cucurbitina</i> (L.) Baillon ex Schum.	A, P	Salt tolerance specie.
25	Butomaceae	<i>Limnocharis flava</i> (L.) Buchenau	A, P	
25	Malvaceae	<i>Hibiscus tiliaceus</i> L.	A, P	Salt tolerance specie.
25	Asteraceae	<i>Pluchea odorata</i> (L.) Cass.	G	Edge of Gatun Lake.
51	Commelinaceae	<i>Commelina erecta</i> L.	G	
51	Cyperaceae	<i>Cyperus entrerianus</i> Boeckl.	G	
51	Cyperaceae	<i>Cyperus</i> sp.	G	
51	Cyperaceae	<i>Scleria eggersiana</i> Boeckl.	G	
51	Gramineae	<i>Hymenachne amplexicaulis</i>	G	
51, 32	Gramineae	<i>Luziola subintegra</i> Swallen	G	
51	Gramineae	<i>Panicum maximum</i> Jacq.	G	
51	Gramineae	<i>Panicum</i> sp.	G	
51	Gramineae	<i>Paspalidium geminatum</i> (Forsk.) Stapf	G	
51	Gramineae	<i>Paspalum</i> sp.	G	
51	Gramineae	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	G	
51	Gramineae	<i>Sacharum spontaneum</i> L.	G	
51	Gramineae	<i>Urochloa mutica</i> (Forsk.) T.Q. Nguyen	G	
51	Heliconiaceae	<i>Heliconia</i> sp.	G	
51	Leguminosae	<i>Senna alata</i> (L.) Roxb.	G	
51, 32	Onagraceae	<i>Jussiaea natans</i> Bonpl.	G	
51	Papilionaceae	<i>Sesbania emerus</i> (Aublet) Urban	G	
32	Parkeriaceae	<i>Ceratopteris pteridoides</i> (Hook.) Hieron.	G	Floating antlerfern.
51	Poaceae	<i>Acroceras zizanioides</i> (Kunth) Dandy	G	
51	Poaceae	<i>Gynerium sagittatum</i> (Aubl.) Beauv.	G	
51	Polygonaceae	<i>Polygonum acuminatum</i> Kunth	G	
51	Polygonaceae	<i>Polygonum hispidum</i> Kunth	G	
51	Pontederiaceae	<i>Pontederia rotundifolia</i> L. f.	G	
51	Pteridacea	<i>Acrostichum aureum</i> L.	G	With Salinity tolerance. Inhabit in brackish swamps

Table 2-2 A. Aquatic Plants Reported in the Lakes Gatún, Miraflores, Atlantic and Pacific Entries of the Panama Canal.

SOURCE	FAMILY	SPECIE	LOCALITY	COMMENTS
51, 25	Alismataceae	<i>Sagittaria lancifolia</i> L.	G, A	Salt tolerance specie.
51, 25	Cyperaceae	<i>Cyperus giganteus</i> Vahl	G, A	Other species are salt tolerant.
51, 25	Cyperaceae	<i>Fimbristylis spathacea</i> Roth	G, A	Salt tolerance specie.
25	Fabaceae	<i>Brownia macrophylla</i> Linden	G, A	Swamps near to the Atlantic coast.
51, 25, 32	Gramineae	<i>Paspalum repens</i> Bergius	G, A	Other species are salt tolerant.
51, 25	Polygonaceae	<i>Polygonum punctatum</i> Ell.	G, A	Salt tolerance specie.
25	Urticaceae	<i>Boehmeria cylindrica</i> (L.) Sw.	G, A	Small-spike false nettle.
51	Araceae	<i>Montrichardia arborescens</i> (L.) Schott	G, A, P	
25	Bombacaceae	<i>Pachira aquatica</i> Aubl.	G, A, P	Grow in wet forest or swamps.
51, 25	Maranthaceae	<i>Thalia geniculata</i> L.	G, A, P	
51, 32	Cyperaceae	<i>Fuirena umbellata</i> Rottb.	G, M	
51	Gramineae	<i>Oriza latifolia</i> Desv.	G, M	
51, 25	Gramineae	<i>Panicum grande</i> Vahl	G, M	Other species are salt tolerant.
32	Gramineae	<i>Luziola</i> sp.	M	
25	Euphorbiaceae	<i>Phyllanthus diffusus</i> Kl.	P	
25	Malvaceae	<i>Kosteletzkyia sagittata</i> C. Presl	P	Other species are salt tolerant.
25	Malvaceae	<i>Pavonia sessiliflora</i> Kunth	P	
		TOTAL OF MARGINAL SPECIES	54	
SUBMERGED				
51, 32	Characeae	<i>Chara</i> sp.	G	
51	Chlorophyta	<i>Nitella</i> sp.	G	
51	Hydrocharitaceae	<i>Vallisneria</i> sp.	G	
51	Lentibulariaceae	<i>Utricularia</i> sp.	G	
51	Mayacaceae	<i>Mayaca</i> sp.	G	
51	Najadaceae	<i>Najas arguta</i> Kunth	G	
32	Najadaceae	<i>Najas guadalupensis</i> (Spreng.) Magnus	G	Guadalupe waternymph. Salinity tolerance between 1 to 7 ppt (32)
32	Najadaceae	<i>Najas marina</i> L.	G	Holly-leaf waternymph.
32	Nymphaeaceae	<i>Cabomba aquatica</i> Aubl.	G	
51	Nymphaeaceae	<i>Cabomba furcata</i> J.A. & J.H. Schultes	G	Forked fanwort.
51, 32	Ceratophyllaceae	<i>Ceratophyllum demersum</i> L.	G, M	
51, 32	Hydrocharitaceae	<i>Hydrilla verticillata</i> (L. f.) Royle	G, M	Present tolerance to salinity between 1 to 7 ppt(32)
		TOTAL OF SUBMERGED SPECIES	12	

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= Gatun Lake

M= Miraflores Lake; PDM: Pedro Miguel Locks.

Table 2-3. List of Plants Associated with the Mangroves of the Caribbean Sea and Pacific Ocean Associated with the Canal of Panama.

SOURCE	CLASS	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Magnoliopsida	Scrophulariales	Bignoniaceae	<i>Tabebuia palustris</i> Hemsl.	P	ME	
55	Magnoliopsida	Rosales	Fabaceae	<i>Mora oleifera</i> (Triana) Ducke	P	ME	
55	Magnoliopsida	Rhizophorales	Rhizophoraceae	<i>Rhizophora X. harrisonii</i> Leechm.	P	ME	
55	Magnoliopsida	Rhizophorales	Rhizophoraceae	<i>Rhizophora racemosa</i> G. Mey.	P	ME	
55, 25	Magnoliopsida	Myrales	Combretaceae	<i>Conocarpus erectus</i> L.	P, A	ME	Button mangrove
55, 25	Magnoliopsida	Myrales	Combretaceae	<i>Laguncularia racemosa</i> (L.) Gaertn. f.	P, A	ME	White mangrove. collected in the mouth of the Chagres river.
55	Magnoliopsida	Rhizophorales	Rhizophoraceae	<i>Rhizophora mangle</i> L.	P, A	ME	American mangrove, Red mangrove. collected in the mouth of the Chagres river.
55, 25	Magnoliopsida	Theales	Theaceae	<i>Pelliciera rhizophorae</i> Triana & Planch.	P, A	ME	Reported to Bahía Las Minas.
55	Magnoliopsida	Lamiales	Verbenaceae	<i>Avicennia bicolor</i> Standl.	P, A	ME	Reported to Bahía Las Minas.
55, 25	Magnoliopsida	Lamiales	Verbenaceae	<i>Avicennia germinans</i> (L.) L.	P, A	ME	Black mangrove. collected in the mouth of the Chagres river.
25	Magnoliopsida	Rhizophorales	Rhizophoraceae	<i>Cassipourea elliptica</i> (Sw.) Poit.	P, A, G	ME	

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= GATUN Lake

M= Marine

E= Estuarine

Table 2-4 A. List of Invertebrates Reported in Gatún and Miraflores Lakes, Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
POLYCHAETS						
UP/ACP04	Aciculata	Goniadidae	<i>Glycinde sp.</i>	P	BMa	
55	Aciculata	Glyceridae	<i>Glycera abranchiata</i> Treadwell	P	BMa	
UP/ACP04	Aciculata	Lumbrineridae	<i>Lumbrinereis sp.</i>	P	BMa	
55	Aciculata	Nephtyidae	<i>Nephrys singularis</i> Hartman	P	BMa	
55	Aciculata	Phyllodocidae	<i>Anaitides multiserrata</i> Rioja	P	BMa	
UP/ACP04	Aciculata	Onuphidae	<i>Diopatra sp.</i>	P	BMa	
55	Aciculata	Phyllodocidae	<i>Anaitides multiserrata</i> Rioja	P	BMa	
55	Canalipalpata	Cirratulidae	<i>Cauillerella alata</i> (Southern)	P	BMa	
55	Canalipalpata	Cirratulidae	<i>Cirratulus cirratus</i> (muller)	P	BMa	
55	Canalipalpata	Magelonidae	<i>Magelona riojai</i> Jones	P	BMa	
UP/ACP04	Canalipalpata	Magelonidae	<i>Magelona sp.</i>	P	BMa	
55	Canalipalpata	Sabellidae	<i>Chone minuta</i> Hartman	P	BMa	
55	Canalipalpata	Spionidae	<i>Displo uncinata</i> Hartman, 1951	A	BMa	
55	Canalipalpata	Spionidae	<i>Scolelepis agilis</i> Verrill	A	BMa	
55	Opheliida	Opheliidae	<i>Armandia bioculata</i> Hartman	P	BMa	
55	Opheliida	Opheliidae	<i>Ophelina sp.</i>	A	BMa	
55	Orbiinida	Paraonidae	<i>Paraonides platybranchia</i> Hartman	P	BMa	
OLIGOCHAETS						
UP/ACP04	Haplotaxida	Tubificidae	<i>Branchiura sowerbyi</i> Beddard, 1892	G, M	BFr	
MOLLUSCS-BIVALVS						
55	Arcoida	Arcidae	<i>Anadara brasiliiana</i> (Lamarck, 1819)	A	BMa	
55	Veneroida	Psammobiidae	<i>Asaphis deflorata</i> (Linnaeus, 1758)	A	BMa	
55	Pterioida	Pinnidae	<i>Atrina seminuda</i> (Lamarck, 1819)	A	BMa	
55	Veneroida	Veneridae	<i>Chione cancellata</i> (Linnaeus, 1767)	A	BMa	
55	Myoida	Corbulidae	<i>Corbula dietziana</i> C. B. Adams, 1852	A	BMa	
55	Myoida	Corbulidae	<i>Corbula swiftiana</i> C. B. Adams, 1852	A	BMa	
55	Veneroida	Lucinidae	<i>Ctena pectinella</i> (C. B. Adams, 1852)	A	BMa	
55	Veneroida	Ungulinidae	<i>Diplodonta notata</i> Dall and Simpson, 1901	A	BMa	
55	Veneroida	Donacidae	<i>Donax denticulatus</i> Linnaeus	A	BMa	
55	Veneroida	Veneridae	<i>Dosinia elegans</i> Conrad	A	BMa	
55	Veneroida	Ungulinidae	<i>Felaniella candeana</i> Orbigny	A	BMa	Cande Diplodon
55	Nuculoida	Nuculidae	<i>Nucula calcicola</i> Moore, 1977	A	BMa	
55	Nuculoida	Nuculidae	<i>Nucula crenulata</i> A. Adams, 1856	A	BMa	
55	Nuculoida	Nuculanidae	<i>Nuculana acuta</i> (Conrad, 1832)	A	BMa	
55	Veneroida	Veneridae	<i>Pitar arestus</i> (Dall and Simpson, 1901)	A	BMa	Pleasing pitar
55	Veneroida	Solecurtidae	<i>Tagelus divisus</i> (Spengler, 1794)	A	BMa	
55	Veneroida	Tellinidae	<i>Tellina listeri</i> Hanley	A	BMa	Speckled tellin
55	Veneroida	Tellinidae	<i>Tellina nitens</i> C. B. Adams,	A	BMa	Shiny dwarf tellin
55	Veneroida	Tellinidae	<i>Tellina similis</i> J. Sowerby, 1806	A	BMa	Candystick tellin
55	Veneroida	Cardiidae	<i>Trachycardium muricatum</i> (Linnaeus, 1758)	A	BMa	
UP/ACP04	Unionoida	Unionidae	<i>Anodonta luteola</i> (Lea, 1858)	G	Fr	Exotic specie and dominant in Garces(2004)
48	Arcoida	Arcidae	<i>Arca sp.</i>	GL	BMa	Collected in the inferior locks at Gatún.
48	Mytiloida	Mytilidae	<i>Brachidontes exustus</i> Linné	GL	BMa	Collected in the inferior locks of Gatún Locks (5-15 ppt).
48	Veneroida	Dreissenidae	<i>Mytilopsis leucophaetus</i> (Conrad, 1831)	GL	BMa	Collected in upper locks of Gatún Locks (0-<1 ppt). Dark falsemussel
UP/ACP04	Veneroida	Pisidiidae	<i>Pisidium sp.</i>	GL	BMa	
UP/ACP04	Veneroida	Corbiculidae	<i>Corbicula fluminea</i> (O. F. Müller, 1774)	G, M	Fr	Exotic specie and dominant in Garces(2004)
48	Veneroida	Dreissenidae	<i>Mytilopsis sallei</i> Recluz	GL, M	BFr	Collected in upper locks of Miraflores Locksde with salinity between 1-6 ppt. Greenberg(48). Collected in the Pedro Miguel Locks.
48	Mytiloida	Mytilidae	<i>Brachidontes sp.1</i>	M	BMa	Collected in Miraflores Lake with salinities betwwen 0-1 ppt.
48	Mytiloida	Mytilidae	<i>Brachidontes sp.2</i>	M	BMa	Collected in Miraflores Lake with salinities betwwen 0-1 ppt.
48	Mytiloida	Mytilidae	<i>Mytella strigata</i> (Hanley, 1843)	M	BMa	Collected in Miraflores Lake with salinities betwwen 0-1 ppt.
48	Veneroida	Dreissenidae	<i>Mytilopsis zeteki</i> Hertlein & Hanna, 1949	ML	BMa	Collected in upper locks of Miraflores Locksde with salinity between 1-6 ppt. Greenberg(48).
48, 21	Ostreoida	Ostreidae	<i>Ostrea palmula</i> Carpenter	M	BMa	Collected in Miraflores Lake with salinities betwwen 0-1 ppt. and at the inferior locks of Miraflores with salinities between 1-6 ppt. Greenberg(48).
48	Myoida	Teredinidae	<i>Psiloteredo miraflora</i> (Bartsch, 1922)	M	BMa	Collected in Miraflores Lake with salinities betwwen 0-1 ppt.

Table 2-4 A. List of Invertebrates Reported in Gatún and Miraflores Lakes, Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
48	Pterioida	Pteriidae	<i>Pteria sterna</i> (Gould, 1851)	ML	Fr	Collected in the inferior locks of Miraflores.
55	Nuculoida	Nuculidae	<i>Adrana cultrata</i> Keen	P	BMa	
52	Nuculoida	Nuculidae	<i>Adrana exopta</i> Pilsbry & Lowe	P	BMa	
52	Nuculoida	Nuculidae	<i>Adrana marella</i> J. G. Hertlein & A. M. Strong	P	BMa	
50	Veneroida	Lasaeidae	<i>Aligena cokeri</i> Dall	P	BMa	
50	Veneroida	Lasaeidae	<i>Amerycina colpoica</i> W. H. Dall	P	BMa	Ref. Bernard, 1983 p 31. <i>Erycina colpoica</i> in Olsson(50).
50	Arcoida	Arcidae	<i>Anadara adamsi</i> Olsson	P	BMa	
50, 55	Arcoida	Arcidae	<i>Anadara concinna</i> Sowerby	P	BMa	
50	Arcoida	Arcidae	<i>Anadara formosa</i> Sowerby	P	BMa	
55	Arcoida	Arcidae	<i>Anadara grandis</i> Broderip and Sowerby	P	BMa	
UP/ACP04	Arcoida	Arcidae	<i>Anadara nux</i> (Sowerby, 1833)	P	BMa	
55	Arcoida	Arcidae	<i>Anadara obesa</i> sowerby	P	BMa	Tentative position in taxonomy
50	Arcoida	Arcidae	<i>Arca mutabilis</i> Sowerby	P	BMa	
50	Arcoida	Arcidae	<i>Arca pacifica</i> Sowerby	P	BMa	Tentative position in taxonomy
50, 55	Pterioida	Pinnidae	<i>Atrina maura</i> Sowerby	P	BMa	Tentative position in taxonomy.
55	Arcoida	Arcidae	<i>Barbatia (Acar) gradata</i> Broderip & Sowerby	P	BMa	Tentative position in taxonomy
55	Arcoida	Arcidae	<i>Barbatia (Acar) rostae</i> Berry	P	BMa	Tentative position in taxonomy
50	Veneroida	Lasaeidae	<i>Bornia venada</i>	P	BMa	
3	Mytiloida	Mytilidae	<i>Brachidontes adamsianus</i> (Dunke, 1857)	P	BMa	Rocky littoral.
3	Mytiloida	Mytilidae	<i>Brachidontes puntarenensis</i> (Pilsbry y Lowe, 1932)	P	BMa	
3	Mytiloida	Mytilidae	<i>Brachidontes semilaevis</i> (Menke, 1894)	P	BMa	Littoral between seaweeds, sublittoral, mangroves.
50	Arcoida	Arcidae	<i>Calloarca alternata</i> Sowerby	P	BMa	
3	Veneroida	Carditaceae	<i>Cardita (Byssomera) affinis</i> Sowebey	P	BMa	Rocky littoral and sublittoral until 27 m
50	Veneroida	Carditaceae	<i>Cardita laticostata</i>	P	BMa	Cardita tricolor in Olsson (50).
50	Veneroida	Carditaceae	<i>Carditamera radiata</i>	P	BMa	
50	Veneroida	Chamidae	<i>Chama buddiana</i>	P	BMa	
						Collected in the inferior locks of Miraflores (5-15 ppt) and in the middle locks of Gatun Locks (0-3 ppt).
48	Veneroida	Chamidae	<i>Chama sp.</i>	P	BMa	
50	Veneroida	Veneridae	<i>Chione amathusia</i> (Philippi, 1844)	P	BMa	Chionopsis amathusia in Olsson (50)
50	Veneroida	Veneridae	<i>Chione kelletii</i> (Hinds, 1845)	P	BMa	
50	Veneroida	Veneridae	<i>Chione montezuma</i> Pilsbry & Lowe	P	BMa	Chionopsis montezuma in Olsson (50)
50	Veneroida	Veneridae	<i>Chione ornatissima</i> (W. J. Broderip, 1835)	P	BMa	Chionopsis ornatissima in Olsson (50)
50	Veneroida	Veneridae	<i>Chione subimbricata</i> Sowerby	P	BMa	
55	Veneroida	Veneridae	<i>Chione subrugosa</i> Woods	P	BMa	
3	Myoida	Corbulidae	<i>Corbula (Juliacorbula) biradiata</i> Sowerby	P	BMa	Littoral y sublittoral to 24 m
50	Myoida	Corbulidae	<i>Corbula amethystina</i> Olsson	P	BMa	Caryocorbula amethystina in Olsson (50)
50	Myoida	Corbulidae	<i>Corbula ira</i> Dall	P	BMa	Juliacorbula ira in Olsson (50)
55, UP/ACP04	Myoida	Corbulidae	<i>Corbula nasuta</i> Sowerby, 1833	P	BMa	
3, 50	Veneroida	Crassatellidae	<i>Crassinella pacifica</i> (C.B. Adams, 1852)	P	BMa	
50	Ostreoida	Ostreidae	<i>Crassostrea cortenziensis</i> Hertlein	P	BMa	
3	Veneroida	Carditaceae	<i>Ctena clippertonensis</i> Barstsch & Rehder	P	BMa	Litoral rocoso y sublitoral hasta 75 m
55	Veneroida	Lucinidae	<i>Ctena mexicana</i> Dall, 1901	P	BMa	
50	Veneroida	Veneridae	<i>Cyclinella jadisi</i> A. A. Olsson, 1961	P	BMa	
50	Veneroida	Veneridae	<i>Cyclinella saccata</i> Gould	P	BMa	
50	Veneroida	Veneridae	<i>Cyclinella singleyi</i> Dall	P	BMa	
50	Veneroida	Cyrenoididae	<i>Cyrenoida panamensis</i> Pilsbry & Rueppell	P	BMa	
50	Veneroida	Veneridae	<i>Cytherea consanguinea</i> C. B. Adams	P	BMa	Pitar consanguineus in Olsson (50)
50	Veneroida	Ungulinidae	<i>Diplodonta subquadrata</i> (P. P. Carpenter, 1856)	P	BMa	Diplodonta suprema in Olsson (50)
3	Veneroida	Donacidae	<i>Donax gracilis</i> Hanley	P	BMa	Littoral y sublittoral until 24 m
3	Veneroida	Donacidae	<i>Donax navicula</i> Hanley	P	BMa	Littoral y sublittoral until 13 m.
3, 55	Veneroida	Donacidae	<i>Donax panamensis</i> Philippi	P	BMa	Littoral
3, 55	Veneroida	Veneridae	<i>Dosinia dunkeri</i> (Philipi, 1844)	P	BMa	Dosina ponderosa in Olsson (50).
50	Veneroida	Veneridae	<i>Dosinia ponderosa</i> (C. F. Schumacher, 1817)	P	BMa	Littoral muddy and sublittoral until 55 m.
50	Veneroida	Tellinidae	<i>Elpidolina decumbens</i> Carpenter	P	BMa	
3, 55	Veneroida	Ungulinidae	<i>Felaniella (Zemysia) sericata</i> (Reeve, 1850)	P	BMa	Littoral and sublittoral arenoso-fangoso hasta 75 m
50	Veneroida	Psammobiidae	<i>Gobraemus panamensis</i> A. A. Olsson, 1961	P	BMa	
50	Veneroida	Psammobiidae	<i>Heterodonax bimaculatus</i> Linnaeus	P	BMa	
						Collected in the inferior locks of Miraflores (5-15 ppt) and in the middle locks of Gatun Locks (0-3 ppt).
48	Pterioida	Isognomonidae	<i>Isognomon bicolor</i>	P	BMa	
50	Veneroida	Cardiidae	<i>Laevicardium clarionense</i> J. G. Hertlein & A. M. Stro	P	BMa	

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Veneroida	Cardiidae	<i>Leavicardium elenense</i> Sowerby	P	BMa	Tentative position in taxonomy.
50	Veneroida	Tellinidae	<i>Leporimetis cognata</i> Pilsbry & Vannata	P	BMa	
50	Veneroida	Veneridae	<i>Leukoma asperrima</i> G. B. Sowerby, 1835	P	BMa	Nioche asperrima in Olsson (50)
52	Arcoida	Limopsidae	<i>Limopsis compressus</i> W. H. Dall	P	BMa	
50	Arcoida	Limopsidae	<i>Limopsis zonalis</i> Dall	P	BMa	
50	Mytiloida	Mytilidae	<i>Lithophaga aristata</i>	P	BMa	
50	Veneroida	Cardiidae	<i>Lophocardium clumingii</i> Broderip	P	BMa	
50	Pholadomyoida	Lyonsiidae	<i>Lyonsia panamensis</i> W. H. Dall	P	BMa	
50	Ostreoida	Pectinidae	<i>Lyropecten subnodosus</i>	P	BMa	
50, 55	Veneroida	Tellinidae	<i>Macoma siliqua</i> C. B. Adams	P	BMa	Psammacoma silicua in Olsson (50)
50, 55	Veneroida	Mactridae	<i>Mactra fonsecana</i> Hertlein & Strong	P	BMa	
52	Veneroida	Mactridae	<i>Mactra corallina</i> C. v Linne, 1758	P	BMa	
50	Myoida	Pholadoidea	<i>Martesia striata</i> Linné	P	BMa	
55	Veneroida	Veneridae	<i>Megapitaria squalida</i> Sowerby	P	BMa	
50	Mytiloida	Mytilidae	<i>Modiolus capax</i>	P	BMa	
50	Veneroida	Tellinidae	<i>Moerella erythronotus</i> Pilsbry & Lowe	P	BMa	
50	Veneroida	Tellinidae	<i>Moerella felix</i> Hanley	P	BMa	
50, 55	Veneroida	Mactridae	<i>Mulinia pallida</i> Broderip & Sowerby	P	BMa	
50	Mytiloida	Mytilidae	<i>Mytilus zeteki</i> L. G. Hertlein & G. D. Hanna	P	BMa	Mytilopsis zeteki in Olsson (50)
UP/ACP04	Nuculoida	Nuculidae	<i>Nucula declivis</i> Hinds, 1843	P	BMa	
50	Nuculoida	Nuculidae	<i>Nucula exigua</i> Sowerby	P	BMa	
50	Nuculoida	Nuculanidae	<i>Nuculana acapulcensis</i> H. A. Pilsbry & H. N. Lowe	P	BMa	
55	Nuculoida	Nuculanidae	<i>Nuculana acrita</i> Dall	P	BMa	
50	Nuculoida	Nuculanidae	<i>Nuculana callimene</i> (Dall, 1908)	P	BMa	
52	Nuculoida	Nuculanidae	<i>Nuculana costellata</i> Sowerby	P	BMa	
50	Nuculoida	Nuculanidae	<i>Nuculana polita</i> Sowerby	P	BMa	
50	Veneroida	Lasaeidae	<i>Oribitella margarita</i> Olsson	P	BMa	
50	Ostreoida	Ostreidae	<i>Ostrea iridescent</i>	P	BMa	
50	Pholadomyoida	Periplomatidae	<i>Periploma carpenteri</i> Dall	P	BMa	
50	Veneroida	Veneridae	<i>Petricolaria cognata</i> C.B. Adams	P	BMa	Petricola cognata in Olsson(50)
3	Veneroida	Veneridae	<i>Pitar (Lamelliconcha) paytensis</i> Orbigny, 1845	P	BMa	
50	Veneroida	Veneridae	<i>Pitar callicomatus</i> (W. H. Dall, 1902)	P	BMa	Lamelliconcha callicomata in Olsson (50).
50	Veneroida	Veneridae	<i>Pitarella catharia</i> Dall	P	BMa	Agriopona(Pitarella) Catharia in Olsson (50)
						Mirocardium panamensis in Olsson (50). Change of name in Bernard, 1983 p 38
50	Veneroida	Cardiidae	<i>Protocardia panamensis</i>	P	BMa	
3	Veneroida	Veneridae	<i>Protothaca (Leukoma) asperrima</i> (Sowerby, 1835)	P	BMa	Twin specie of Protothaca pectorina from the Caribbean sea. Littoral fmuddy-rocky, mangrove
50	Veneroida	Veneridae	<i>Protothaca (Leukoma) macgintyi</i> (A. A. Olsson, 1961)	P	BMa	Nioche macgintyi in Olsson (50)
50, 55	Veneroida	Tellinidae	<i>Psammotreta aurora</i> Hanley	P	BMa	
50	Veneroida	Tellinidae	<i>Psammotreta gubernacula</i> Hanley	P	BMa	
50	Pterioida	Pteriidae	<i>Pteria beliana</i> A.A. Olsson	P	BMa	
3	Veneroida	Semelidae	<i>Semele formosa</i> (Sowerby, 1833)	P	BMa	Littoral
50	Veneroida	Semelidae	<i>Semele guaymasensis</i> Pilsbry & Lowe	P	BMa	
50	Veneroida	Semelidae	<i>Semele rosea</i> Sowerby	P	BMa	Semele tabogensis in Olsson (50)
50	Veneroida	Semelidae	<i>Semele venusta</i> Reeve	P	BMa	
3, 50	Myoida	Myidae	<i>Spheria fragilis</i> (H. Y A. Adams, 1854)	P	BMa	It Lodges at cavities excavated in other conches.
50	Veneroida	Mactridae	<i>Spisula adamsi</i> Olssom	P	BMa	
3, 50	Veneroida	Solecurtidae	<i>Tagelus (Tagelus) affinis</i> (C.B. Adams, 1852)	P	BMa	Twin specie of Tagelus plebius from the Caribbean sea. Swampy littoral y sublittoral until 73 m
55	Veneroida	Solecurtidae	<i>Tagelus politus</i> Carpenter	P	BMa	
50	Veneroida	Solecurtidae	<i>Tagelus preuanus</i> Dunker	P	BMa	
3	Veneroida	Tellinidae	<i>Tellidora burneti</i> Broderip & Sowerby	P	BMa	
50	Veneroida	Tellinidae	<i>Tellina (Angulus) amianta</i> Dall, 1900	P	BMa	Twin specie of Tellina gibber from the Caribbean sea. Sublittoral until 4-55 m.
3, 55	Veneroida	Tellinidae	<i>Tellina (Eurytellina) inaequistriata</i> Donovan, 1802	P	BMa	Twin specie of Tellina nitens from the Caribbean sea. Sublittoral from 18-33 m.
52	Veneroida	Tellinidae	<i>Tellina cumungii argis</i> Olsson	P	BMa	Tellina argis in Olsson (52)
50, 55	Veneroida	Tellinidae	<i>Tellina eburnea</i> hanley	P	BMa	
55	Veneroida	Tellinidae	<i>Tellina insculpta</i> Hanley	p	BMa	
50	Veneroida	Tellinidae	<i>Tellina lyra</i> S. C. T. Hanley	P	BMa	Lyratellina lyra in Olsson (50)

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55	Veneroida	Tellinidae	<i>Tellina nicoyana</i> Hertlein & Strong	P	BMa	
50	Veneroida	Tellinidae	<i>Tellina prora</i> Hanley	P	BMa	Eurytellina prora in Olsson (50)
50, 55	Veneroida	Tellinidae	<i>Tellina rubescens</i> Hanley	P	BMa	
55	Veneroida	Tellinidae	<i>Tellina spp.</i>	P	BMa	
55	Veneroida	Tellinidae	<i>Tellina substrigosa</i> Sowerby in Reeve	P	BMa	
55	Veneroida	Veneridae	<i>Tivela (Tivela) argentina</i> Sowerby	P	BMa	
55	Veneroida	Cardiidae	<i>Trachycardium senticosum</i> Sowerby	P	BMa	
3	Veneroida	Veneridae	<i>Transennella modesta</i> (Sowby, 1853)	P	BMa	From sublittoral until 90 m.
55	Veneroida	Cardiidae	<i>Trigonocardia granifera</i> Broderip & Sowerby	P	BMa	
55	Veneroida	Cardiidae	<i>Trigonocardia obovalis</i> Sowerby	P	BMa	
50, 55	Veneroida	Tellinidae	<i>Tellina alternata</i> Say	P, A	BMa	Eurytellina hertleini in Olsson (50)
41	Myoida	Teredinidae	<i>Bankia</i> sp.	P, A	BMa	
41	Myoida	Teredinidae	<i>Teredo (N.) Miraflores</i>	P, A, M	BMa	
MOLLUSC-GASTROPODS						
55	Archaeogastropoda	Tricoliidae	<i>Tricolia affinis</i> (C. B. Adams, 1850)	A	BMa	
48	Architaenioglossa	Ampullariidae	<i>Pomacea flagellata</i> Say, 1827	G	Fr	
48	Caenogastropoda	Pediculariidae	<i>Jenneria pustulata</i> (Lightfoot 1786)	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
52	Caenogastropoda	Buccinidae	<i>Cantharus panamicus</i> Hertlein & Strong	P	BMa	
55	Caenogastropoda	Buccinidae	<i>Phos fusoides</i> C.B. Adams	P	BMa	
48	Caenogastropoda	Buccinidae	<i>Triumphis distorta</i> (Wood, 1828)	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
48	Caenogastropoda	Buccinidae	<i>Triumphis subrostrata</i> (Wood, 1828)	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
55	Caenogastropoda	Calyptraeidae	<i>Calyptraea conica</i> Broderip	P	BMa	
55	Caenogastropoda	Calyptraeidae	<i>Calyptraea mammilaris</i> Broderip	P	BMa	
48	Caenogastropoda	Calyptraeidae	<i>Crepidula aculeata</i> (Gmelin, 1791)	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
48	Caenogastropoda	Calyptraeidae	<i>Crepidula incurvata</i> (Broderip, 1834)	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
55	Caenogastropoda	Calyptraeidae	<i>Crepidula onyx</i> G. B. Sowerby	P	BMa	
48	Caenogastropoda	Calyptraeidae	<i>Crucibulum personatum</i> Keen, 1958	ML	BMa	Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48).
48, 55	Caenogastropoda	Calyptraeidae	<i>Crucibulum spinosum</i> (Sowerby, 1824)	ML, P	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt Greenberg (48). Spiny cup-and-saucer
UP/ACP04	Caenogastropoda	Columbellidae	<i>Strombina turrita</i> (Sowerby, 1832)	P	BMa	
55	Caenogastropoda	Conidae	<i>Comus patricius</i> Hinds	P	BMa	
53	Caenogastropoda	Conidae	<i>Conus arcuatus</i> Broderip and Sowerby	P	BMa	
55	Caenogastropoda	Conidae	<i>Conus chrysostestus</i> S. S. Berry, 1968	P	BMa	<i>Conus fergusoni</i> Sowerby in (55).
55	Caenogastropoda	Conidae	<i>Conus ximenes</i> Gray, 1839	P	BMa	<i>Conus mahogani</i> Reeve in (55)
55	Caenogastropoda	Fasciolariidae	<i>Fusinus</i> sp.	P		
55	Caenogastropoda	Littorinidae	<i>Littorina aspera</i>	P		
48	Caenogastropoda	Melongenidae	<i>Melongina patula</i> (Broderip & Sowerby)	M	BMa	Collected in the de Miraflores Lake with salinity between 0-1 ppt.
52	Caenogastropoda	Muricidae	<i>Bayerius fragilissimus</i> W. H. Dall	P		
52	Caenogastropoda	Muricidae	<i>Brachytoma stromboides</i> Sowerby	P		
48	Caenogastropoda	Muricidae	<i>Eupleura nitida</i> (Broderip, 1833)	ML	BMa	Collected in the upper locks of Miraflores Locks with salinity between 1-6 ppt. Greenberg(48)
52	Caenogastropoda	Muricidae	<i>Glyphostoma bayeri</i> A. A. Olsson	P	BMa	
52	Caenogastropoda	Muricidae	<i>Knefastia pilosbryi</i> Lowe	P	BMa	
48, 55	Caenogastropoda	Ranellidae	<i>Cymatium wiegmanni</i> (Anton, 1839)	ML	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt. Greenberg (48). Specie placed in the Family Cymatidae in (48).
48	Caenogastropoda	Thaidinae	<i>Thais biserialis</i> (Blainville, 1832)	ML, P	BMa	Collected at the Lower locks in Miraflores Lake. at salinity between 11-31 ppt Greenberg (48). Greenberg(48).
48	Caenogastropoda	Thaidinae	<i>Thais chocolatana</i>	ML	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt, Greenberg (48).
48	Caenogastropoda	Thaidinae	<i>Thais haematoma floridana</i> (Conrad, 1837)	G	BMa	Collected at the Lower locks in Gatún (5-15 ppt).

Table 2-4 A. List of Invertebrates Reported in Gatún and Miraflores Lakes, Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
48	Caenogastropoda	Thaidinae	<i>Thais kiosquiformis</i> (Duclos, 1832)	ML	BMa	Collected in upper locks of Miraflores Locks with salinity between 1-6 ppt and in the lower locks too, Greenberg(48).
48	Caenogastropoda	Thaidinae	<i>Thais sp.2</i>	M	BMa	Collected in the Miraflores Lake. Salinity between 0-1 ppt.
55	Cephalaspidea	Bullidae	<i>Bulla gouldiana</i> Pilsbry, 1895	P	BMa	
55	Cephalaspidea	Cylichnidae	<i>Actaecina recta</i> (d'Orbigny, 1841)	A	BMa	
55	Cephalaspidea	Cylichnidae	<i>Cylichna veleroris</i> Strong & Hertlein	P	BMa	
55	Cephalaspidea	Cylichnidae	<i>Cylichna verrilli</i> Dall	A	BMa	
55	Heterostropha	Pyramidellidae	<i>Sayella fusca</i> (C. B. Adams, 1839)	A	BMa	
3	Mesogastropoda	Vitrinellidae	<i>Solariorbis (Solariorbis) minutus</i> (C.B. Adams, 1852)	P	BMa	
52	Neogastropoda	Buccinidae	<i>Engina macleani</i> Olsson	P	BMa	
55	Neogastropoda	Cancellariidae	<i>Cancellaria albida</i> Hinds, 1843	P	BMa	
48	Neogastropoda	Collumbellidae	<i>Anachis decimdentata</i> Pilsbry & Lowe, 1932	ML	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt, Greenberg (48).
48	Neogastropoda	Collumbellidae	<i>Anachis lyrata</i> (Sowerby, 1832)	ML	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt, Greenberg (48).
48	Neogastropoda	Collumbellidae	<i>Anachis scalarina</i> (Sowerby, 1832)	ML	BMa	Collected at the Lower locks in Miraflores Lake at salinity between 11-31 ppt, Greenberg (48).
55	Neogastropoda	Columbellidae	<i>Anachis sparsa</i> (Reeve, 1859)	A	BMa	
55	Neogastropoda	Columbellidae	<i>Cosmioconcha modesta</i> (Powys, 1935)	P	BMa	
55	Neogastropoda	Columbellidae	<i>Strombina recurva</i> Sowerby	P	BMa	
55	Neogastropoda	Cystiscidae	<i>Gibberula lavalleana</i> (d'Orbigny, 1842)	A	BMa	
55	Neogastropoda	Fasciolariidae	<i>Latirus hemphilli</i> Hertein & Strong	P	BMa	
52	Neogastropoda	Fasciolariidae	<i>Latirus tumens</i> Carpenter	P	BMa	
55	Neogastropoda	Ficidae	<i>Ficus ventricosa</i> Sowerby	P	BMa	
55	Neogastropoda	Marginellidae	<i>Hyalina gracilis</i> (C. B. Adams, 1851)	A	BMa	
55	Neogastropoda	Marginellidae	<i>Marginella sapotilla</i> Hinds	P	BMa	
55	Neogastropoda	Mitridae	<i>Mitra gigantea</i> Reeve	P	BMa	
3	Neogastropoda	Mitridae	<i>Subcancilla sulcata</i> (Swainson in Sowerby, 1825)	P	BMa	Littoral area collected.
3	Neogastropoda	Nassariidae	<i>Nassarius luteostoma</i> (Broderip y Sowerby, 1829)	P	BMa	Littoral area collected.
55	Neogastropoda	Nassariidae	<i>Nassarius pagodus</i> (Reeve, 1844)	P	BMa	
UP/ACP04	Neogastropoda	Nassariidae	<i>Nassarius sp</i>	P	BMa	
3	Neogastropoda	Naticidae	<i>Natica (Natica) chemnitzii</i> Pfeiffer, 1840	P	BMa	Littoral muddy area collected. Sandy border in mangroves area.
3	Neogastropoda	Naticidae	<i>Natica (Natica) unifasciata</i> Lamarck 1822	P	BE	sandy border in mangroves.
3. 55	Neogastropoda	Naticidae	<i>Natica (Stimaulax) elena</i> Récluz, 1844	P	BMa	Littoral area collected.
55	Neogastropoda	Naticidae	<i>Natica broderiana</i> Récluz	P	BMa	
55	Neogastropoda	Naticidae	<i>Natica natica grayi</i> Philippi, R.A., 1852	P	BMa	
3	Neogastropoda	Naticidae	<i>Polineces (Polineces) otis</i> (Broderip y Soewerby, 182	P	BMa	Sublittoral and upper area in the littoral muddy zone.
55	Neogastropoda	Naticidae	<i>Polineces uber</i> Valenciennes	P	BMa	
55	Neogastropoda	Olividae	<i>Olivella bullata</i> Reeve	A	BMa	
55	Neogastropoda	Olividae	<i>Olivella petiolata</i> Duclos	A	BMa	
55	Neogastropoda	Olividae	<i>Olivella semistriata</i> Gray	P	BMa	
52	Neogastropoda	Terebridae	<i>Terebra argosyia</i> Olsson	P	BMa	
55	Neogastropoda	Terebridae	<i>Terebra cinerea</i> Born	A	BMa	
55	Neogastropoda	Terebridae	<i>Terebra formosa</i> Deshayes	P	BMa	
55	Neogastropoda	Turridae	<i>Polystira oxytropis</i> (Sowerby, 1834)	P	BMa	
54	Neogastropoda	Volutidae	<i>Scaphella evelina</i> F. M. Bayer	A	BMa	
55	Neotaenioglossa	Caecidae	<i>Caecum nitidum</i> Stimpson	A	BMa	
55	Neotaenioglossa	Eulimidae	<i>Eulima bifasciata</i> D'Orbigny	A	BMa	
51	Neotaenioglossa	Hydrobiidae	<i>Pyrgophorus coronatus</i> (Pfeiffer)	G	BMa	
55	Neotaenioglossa	Personidae	<i>Distorsio decussata</i> (Valenciennes, 1832)	P	BMa	
48, 51, UP/ACP04	Neotaenioglossa	Thiaridae	<i>Melanoides tuberculata</i> (Muller, 1774)	G, M	Fr	
55	Neritopsina	Neritidae	<i>Nerita funiculata</i>	P	BMa	
48	Neritopsina	Neritidae	<i>Neritina latissima</i> Broderip, 1833	ML	BMa	Collected in the upper locks of Miraflores Locks with salinity between 1-6 ppt. Greenberg(48).
48	Neritopsina	Neritidae	<i>Neritina meleagris</i> Lamarck, 1822	G	BMa	Collected at the Lower (salinity between 5-15 ppt), middle (0-3 ppt) and upper locks of Gatun Locks System (0-<1 ppt).
48	Neritopsina	Neritidae	<i>Neritina piratica</i> (Russell, 1940)	G	BMa	Collected in the upper locks of Gatun Locks System (0-<1 ppt)
48	Neritopsina	Neritidae	<i>Neritina reclivata</i> (Say, 1822)	G	BMa	Collected in the upper locks of Gatun Locks System (0-<1 ppt)
48	Neritopsina	Neritidae	<i>Neritina sp.1</i>	M	BMa	Collected in the Miraflores Lake with salinities between 0-1 ppt.
54	Stenoglossa	Columbariidae	<i>Columbarium brayi</i>	A	BMa	

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
SPONGES						
55	Axinellidae	Agelasidae	<i>Agelus sparsus</i> Gray	A	BMa	
47	Hadromerida	Clionidae	<i>Cliona caribbea</i> Carter, 1882	P, A	BMa	Fouling sponges in coral reefs.
55	Sycettida	Sycettidae	<i>Scypha sp.</i>	A	BMa	
55	Verongida	Aplysinidae	<i>Aplysina fistularis insularis</i> Duchassing & Michelotti	A	BMa	
SPINCOLA						
55, UP/ACP04		Phascolionidae	<i>Phascolion sp.</i>	P, A	BMa	
CHAETOGNATE						
55		Sagittidae	<i>Sagitta sp1.</i>	P	BMa	Worms predators.
55		Sagittidae	<i>sagitta sp2.</i>	A	BMa	
BRYOZOANS						
55	Cheilostomata	Calpensiidae	<i>Discoporella umbellata</i>	A	BMa	
55	Cheilostomata	Membraniporae	<i>Cupuladria biporosa</i> Canu & Bassler	A	BMa	
55	Cheilostomata	Membraniporae	<i>Cupuladria canariensis</i> Busk	A	BMa	
55	Cheilostomata	Reteporidae	<i>Sertella atlantica</i> Busk & cook	A	BMa	
55	Cheilostomata	Schizoporellidae	<i>Stylopma n.sp.</i>	A	BMa	
55	Cyclostomata	Tubuliporidae	<i>Stomatopora poligona</i> Canu & Bassler	A	BMa	
55	Cheilostomata	Farciminiidae	<i>Nellia tenella</i> Levinsen	P	BMa	
55	Cheilostomata	Teuchoporidae	<i>Lagenicella marginata</i> (Canu and Bassler, 1930)	P	BMa	
21	Anasca	Bugulidae	<i>Bugula neritina</i> (Linnaeus, 1758)	P, A	Ma	colonial animals
42	Anasca	Bugulidae	<i>Bugula stolonifera</i> Ryland, 1960	P, A	Ma	Eurihaline, colonial animals
42	Cheilostomata	Electridiae	<i>Electra monostachys</i> Busk	P, A	Ma	Eurihaline, colonial animals
21	Cheilostomata	Membraniporae	<i>Membranipora savartii</i> Audouin	P, A	BMa	According to Cargo (21), this species is in both earnings of the Canal.
42	Cheilostomata	Membraniporae	<i>Sinoflustra annae</i> Osburn	P, A	BMa	Eurihaline, colonial animals
BRACHIOPODS						
55	Lingulida	Lingulidae	<i>Lingula sp.</i>	P	BMa	
55	Lingulida	Lingulidae	<i>Glottidia sp.</i>	P	BMa	
CEPHALOCORDATES						
		Branchiostomidae	<i>Branchiostoma californiense</i>	P	BMa	
ECHINODERMS						
82	Diadematoida	Diadematidae	<i>Astropyga magnifica</i> Clark A. H.	A	Ma	
82	Arbacioida	Arbaciidae	<i>Arbacia punctulata</i> (Lamarck, 1816)	A	Ma	
82	Arbacioida	Arbaciidae	<i>Arbacia stellata</i> Gmelin, 1872	P	Ma	
82	Camarodonta	Toxopneustidae	<i>Tripneustes depressa</i> Agassiz	P	Ma	<i>Tripneustes depressus</i> in (55).
82	Camarodonta	Toxopneustidae	<i>Tripneustes ventricosus</i> (Lamarck, 1916)	A	Ma	
82	Cassiduloida	Cassidulidae	<i>Cassidulus caribaeorum</i> Lamarck, 1801	A	Ma	
82	Cassiduloida	Cassidulidae	<i>Cassidulus pacificus</i> Agassiz	P	Ma	
82, 55	Cidaroida	Cidaridae	<i>Eucidaris thouarsii</i> (Valenciennes, 1846)	P	BMa	
82	Cidaroida	Cidaridae	<i>Eucidaris tribuloides</i> (Lamarck, 1816)	A	BMa	
82, 55	Clypeasteroida	Clypeasteridae	<i>Clypeaster rotundus</i> A. Agassiz	P	BMa	
82	Clypeasteroida	Clypeasteridae	<i>Clypeaster subdepressus</i> (Gray, 1825)	A	Ma	
82, 55	Clypeasteroida	Mellitidae	<i>Encope emarginata</i> (Leske, 1778)	A	BMa	
82, 55	Clypeasteroida	Mellitidae	<i>Encope micropora</i> L. Agassiz	P	BMa	
55	Clypeasteroida	Mellitidae	<i>Leodia sexiesperforata</i> (Leske, 1778)	A	BMa	
82	Clypeasteroida	Mellitidae	<i>Mellita lata</i> Clark	A	BMa	
82, 55	Clypeasteroida	Mellitidae	<i>Mellitta longifissa</i> Michelin	P	BMa	
82	Diadematoida	Diadematidae	<i>Astropyga pulvinata</i> (Lamarck)	P	Ma	
82	Diadematoida	Diadematidae	<i>Diadema antillarum</i> (Philippi, 1845)	A	Ma	
82, 55	Diadematoida	Diadematidae	<i>Diadema mexicanum</i> A. Agassiz	P	BMa	
82	Echinoidea	Echinometridae	<i>Echinometra lucunter</i> (Linnaeus, 1758)	A	BMa	rock boring urchin
82, 55	Echinoidea	Echinometridae	<i>Echinometra van brunti</i> A. Agassiz	P	BMa	
55	Ophiurida	Amphiuridae	<i>Opionereis dolabriformis</i> John & Clark	A	BMa	
55	Ophiurida	Ophiothrichidae	<i>Ophiothrix oerstedii</i> Lutken	A	BMa	

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Ophiurida	Ophiothricidae	<i>Ophiothrix spiculata</i> Le Conte	P	BMa	
21	Paxillosida	Astropectinidae	<i>Astropecten armatus</i> Doderlein, 1917	P	BMa	
55	Paxillosida	Astropectinidae	<i>Astropecten marginatus</i> Gray	A	BMa	
55	Paxillosida	Linckiidae	<i>Pharia pyramidata</i> Gray	P	BMa	
55	Paxillosida	Linckiidae	<i>Pharia unifasciata</i> Gray	P	BMa	
82	Spatangoidea	Brissidae	<i>Brissus obesus</i> Verrill	P	BMa	
82	Spatangoidea	Brissidae	<i>Brissus unicolor</i> (Leske, 1778)	A	BMa	
82	Spatangoidea	Brissidae	<i>Meoma grandis</i> Gray	P	BMa	
82, 55	Spatangoidea	Brissidae	<i>Meoma ventricosa</i> (Lamarck, 1816)	A	BMa	
55	Spatangoidea	Brissidae	<i>Metalia nobilis</i> Verrill	P	BMa	
82	Spatangoidea	Brissidae	<i>Plagiobrissus grandis</i> Gmelin	A	BMa	
82	Spatangoidea	Brissidae	<i>Plagiobrissus pacificus</i> Clark	P	BMa	
82	Spatangoidea	Hemasteridae	<i>Agassizia excentrica</i> A. Agassiz	A	BMa	
82, 55	Spatangoidea	Hemasteridae	<i>Agassizia scrobiculata</i> Val.	P	BMa	
82	Spatangoidea	Schizasteridae	<i>Moira atropos</i> Lamarck	A	BMa	
82	Spatangoidea	Schizasteridae	<i>Moira clothe</i> Michelin	P	BMa	
82	Temnopleuroidea	Toxopneustidae	<i>Lytechinus williamsi</i> Chesher	A	BMa	
55	Temnopleuroidea	Toxopneustidae	<i>Toxopneustes roseus</i> Agassiz	P	BMa	
55	Temnopleuroidea	Toxopneustidae	<i>Tripneustes depressa</i> Agassiz	P	BMa	Tripneustes depressus in (55).
82	Temnopleuroidea	Toxopneustidae	<i>Tripneustes ventricosus</i> (Lamarck, 1916)	P	BMa	
42	Valvatida	Acanthasteridae	<i>Acanthaster planci</i> (L.)	P	BMa	Predator of corals.
Poliplacofora						
48	Neoloricata	Ischnochitonidae	<i>Chaetopleura lanuginosa mixta</i> W. H. Dall, 1919	M	BMa	Reported by Greenberg(48) how <i>Chaetopleura mixta</i> , Chiton
Cephalopoda						
48	Teuthida	Loliginidae	<i>Loligo</i> sp.	ML	BMa	Lower locks of the Lake Miraflores to salindades of 11-31 ppt Greenberg (48).
55	Teuthida	Loliginidae	<i>Lolliguncula panamensis</i> Berry	P	BMa	Panama brief squid.
49	Decapoda	Alpheidae	<i>Alpheus malleator</i> Dana	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus armatus</i> Rathbun	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus bouvieri</i> A. Milne-Edwards	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus cristulifrons</i> Rathbun	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus formosus</i> Gibbes	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus peasei</i> (Armstrong, 1940)	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus schmitti</i> Chace, 1972	A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus viridari</i> (Armstrong, 1949)	A	Ma	Caribbean entrances to the Canal.
55	Isopoda	Ancinidae	<i>Ancinus brasiliensis</i> Lemos de Castro	A	Ma	
49	Decapoda	Alpheidae	<i>Automate gardineri</i> Coutiere	A	Ma	Pacific entrances to the Canal
55	Isopoda	Anthuridae	<i>Cyathura n. sp.</i>	A	Ma	
55	Myodocopida	Cypridinidae	<i>Cypridina sp.2</i>	A	Ma	
55	Cumacea	Diastylidae	<i>Diastylis sp.2</i>	A	Ma	
55	Decapoda	Hippidae	<i>Emerita brasiliensis</i> Schmitt	A	Ma	
55	Mysida	Mysidae	<i>Gastrosaccus</i> sp.	A	Ma	
55	Isopoda	Gnathiidae	<i>Gnathia</i> sp.	A	Ma	
55	Decapoda	Calappidae	<i>Hepatus gronovii</i> Holthuis	A	Ma	
55	Decapoda	Calappidae	<i>Hepatus princeps</i> Herbst	A	Ma	
55	Decapoda	Albuneidae	<i>Lepidopa dexteræ</i> Abele & Efford	A	Ma	Inhabit in sandy beach, Caribbean entrances to the Canal.
55	Decapoda	Albuneidae	<i>Lepidopa venusta</i> Stimpson, 1860	A	Ma	
55	Amphipoda	Isaeidae	<i>Micropropotus</i> sp.	A	Ma	
55	Stomatopoda	Nannosquillidae	<i>Nannosquilla vasquezii</i> Manning	A	Ma	
55	Decapoda	Palaemonidae	<i>Palaemon</i> sp.2	A	Ma	
55	Decapoda	Leucosiidae	<i>Persephona punctata</i>	A	Ma	
55	Decapoda	Raninidae	<i>Raninoides loevis</i> (Latreille, 1825)	A	Ma	Furrowed frog crab
55	Isopoda	Sphaeromatidae	<i>Serolis mgrayi</i> Menzies and Frankenberg, 1966	A	Ma	
55	Decapoda	Grapsidae	<i>Sesarma</i> sp.2	A	Ma	
55	Decapoda	Grapsidae	<i>Sesarma</i> sp.3	A	Ma	
55	Decapoda	Grapsidae	<i>Sesarma</i> sp.4	A	Ma	
55	Stomatopoda	Squillidae	<i>Squilla</i> sp.2	A	Ma	
55	Stomatopoda	Squillidae	<i>Squilla</i> sp.1	A	Ma	
49	Decapoda	Alpheidae	<i>Synalpheus fritzmuelleri</i> Coutiere, 1909	A	Ma	Caribbean entrances to the Canal.

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Decapoda	Alpheidae	<i>Synalpheus sp.2</i>	A	Ma	
55	Amphipoda	Phoxocephalidae	<i>Trichophoxus floridanus</i>	A	Ma	
55	Decapoda	Portunidae	<i>Arenaeus cribarius</i> (Lamarck, 1818)	A	Ma	
55	Decapoda	Penaeidae	<i>Farfantepenaeus brasiliensis</i> (Latreille, 1817)	A	Ma	
55	Decapoda	Portunidae	<i>Lupella forceps</i>	A	Ma	
55	Decapoda	Portunidae	<i>Portunus anceps</i> (Saussure, 1858)	A	Ma	
55	Decapoda	Portunidae	<i>Portunus spinicarpus</i> (Stimpson, 1871)	A	Ma	
49, 91	Decapoda	Palaemonidae	<i>Palaemon pandaliformis</i> Stimpson	A, G, PDM	Ma	
49, 91	Decapoda	Atyidae	<i>Atya innocous</i> (Herbst, 1792)	G	Fr	Collected in Barro Colorado Island. Basket shrimp
49, 91	Decapoda	Atyidae	<i>Atya scabra</i> (Leach, 1815)	G	Fr	Collected in Barro Colorado Island.
UP/ACP	Decapoda	Palaemonidae	<i>Macrobrachium amazonicum</i> Heller, 1862	G	Fr	
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium carcinus</i> Linnaeus	G	Fr	Collected in Barro Colorado Island.
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium crenulatum</i> Holthuis	G	Fr	
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium heterochirius</i> Wiegmann	G	Fr	
UP/ACP	Decapoda	Palaemonidae	<i>Macrobrachium sp</i>	G	Fr	
49, 91	Decapoda	Atyidae	<i>Micratya poeyi</i> (Guerin-Mèneville, 1855)	G	Fr	Collected in Barro Colorado Island.
UP/ACP	Decapoda	Palaemonidae	<i>Macrobrachium sp2</i>	G, M	Fr	
49, 91	Decapoda	Atyidae	<i>Potimirin glabra</i> Kingsley, 1878	G, M	Ma, Fr	Collected in Barro Colorado Island.
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium tenellum</i> Smith	G, ML	Fr	Miraflores Locks spillway
49, 91	Decapoda	Atyidae	<i>Potimirin mexicana</i> De Saussure	GL	Fr	Collected near to the Gatun Locks.
49	Decapoda	Portunidae	<i>Callianectes sapidus</i> Rathbun	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Eurypanopeus dissimilis</i> (Benedict and Rathbun, 189	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Hexapanopeus caribbaeus</i> (Stimpson, 1871)	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Hexapanopeus paulensis</i> Rathbun	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Menippe nodifrons</i> Stimpson	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Panopeus herbstii</i> H. Milne-Edwards	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Panopeus rugosus</i> A. Milne-Edwards	GL	Ma	Gatun Locks
49	Decapoda	Xanthidae	<i>Pilumnus dasypodus</i> Kingsley	GL	Ma	Gatun Locks
49	Decapoda	Alpheidae	<i>Alpheus heterochaelis</i> Say	GL	Ma	Collected in Gatun Locks, lower chamber.
49	Decapoda	Palaemonidae	<i>Leander paulensis</i> Ortmann	GL	Ma	Gatun Locks, lower chamber
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium acanthurus</i> Wiegmann	GL	Ma	Collected in the lowe chamber of Gatun Locks.
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium americanum</i> Bate	GL	Ma	Collected in the lowe chamber of Gatun Locks.
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium olfersii</i> Wiegmann	GL	Ma	Collected in Gatun Locks, upper chamber.
49	Decapoda	Grapsidae	<i>Pachygrapsus gracilis</i> (De Saussure, 1858)	GL	Ma	Collected in Gatun Locks
49	Decapoda	Diogenidae	<i>Clibanarius vittatus</i> Bosc	GL	Ma	Collected in Gatun Locks, lower chamber.
91, 49	Decapoda	Alpheidae	<i>Synalpheus apiceros</i> Coutiere	GL, A	Ma	Caribbean entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus armillatus</i> H. Milne-Edwards	GL, ML, A	Ma	Collected in Gatun and Miraflores Locks.
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium digitus</i> Abele	M	Fr	
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium panamense</i> Rathbun, 1912	M	Fr	Collected in Miraflores Locks.
91	Decapoda	Alpheidae	<i>Synalpheus superus</i> Abele	M	Ma	Collected in Miraflores Locks
49	Decapoda	Ocypodidae	<i>Uca brevifrons</i>	M	Ma	
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium crebum</i> Abele	M	Ma	New specie collected in the third locks in Miraflores lake .
49	Decapoda	Alpheidae	<i>Synalpheus cf. paulsoni</i>	M	Ma	Miraflores Locks.
91	Decapoda	Alpheidae	<i>Synalpheus recessus</i> Abele	M	Ma	Collected in Miraflores Locks
49, 91	Decapoda	Palaemonidae	<i>Palaemon hancocki</i> Holthuis	ML	Fr	Miraflores Locks. Maybe introduced
49	Decapoda	Xanthidae	<i>Eurypanopeus confragosus</i> Rathbun	ML	Ma	Miraflores Locks.
49	Decapoda	Parthenopidae	<i>Heterocrypta occidentalis</i> (Dana, 1854)	ML	Ma	Miraflores Locks.
49	Decapoda	Grapsidae	<i>Pachygrapsus transversus</i> (Gibbes, 1850)	ML	Ma	Collected at Miraflores Locks.
49, 91	Decapoda	Palaemonidae	<i>Palaemon gracilis</i> Smith	ML	Ma	Miraflores Locks spillway
49, 91	Decapoda	Palaemonidae	<i>Palaemon schmitti</i> Holthuis	ML	Ma	Miraflores Locks.
55	Stomatopoda	Nannosquillidae	<i>Acanthosquilla digueti</i> Coutiere	P	Ma	
55	Decapoda	Albuneidae	<i>Albunea lucasia</i> Saussure	P	Ma	Inhabit in sandy beach, Pacific entrances to the Canal.
49	Decapoda	Alpheidae	<i>Alpheus californiensis</i> Holmes, 1900	P	Ma	Pacific entrances to the Canal
49	Decapoda	Alpheidae	<i>Alpheus lottini</i> Guerin	P	Ma	Pacific entrances to the Canal
49	Decapoda	Alpheidae	<i>Alpheus panamensis</i> Kingsley	P	Ma	Pacific entrances to the Canal
55	Decapoda	Processidae	<i>Ambidexter panamensis</i> Abele	P	Ma	
55	Amphipoda	Ampeliscidae	<i>Ampelisca holmesi</i> Pearse	P	Ma	
55	Isopoda	Ancinidae	<i>Ancinus panamensis</i> Glynn & Glynn	P	Ma	
55	Decapoda	Callianassidae	<i>Callianassa sp.</i>	P	Ma	
55, 49	Decapoda	Portunidae	<i>Callianectes rathbunae</i> Contreras	P	Ma	Emerita rathbunae Schmitt in (55)

Table 2-4 A. List of Invertebrates Reported in Gatún and Miraflores Lakes, Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Isopoda	Holothuriidae	<i>Cleantiooides occidentalis</i> (Richardson, 1899)	P	Ma	
55	Isopoda	Anthuridae	<i>Cyathura guaroensis</i> Brusca & Weinberg	P	Ma	
55	Myodocopida	Cypridinidae	<i>Cypridina sp.1</i>	P	Ma	Order Myodocopoda in (55)
55	Cumacea	Diastylidae	<i>Diastylis sp.1</i>	P	Ma	
55	Isopoda	Cirolanidae	<i>Exciorlana chamensis</i> Brusca & Weinberg	P	Ma	
55	Isopoda	Sphaeromatidae	<i>Exosphaeroma diminutum</i> Menzies & Frankenberg,	P	Ma	
55	Decapoda	Calappidae	<i>Hepatus kossmanni</i> Neumann	P	Ma	
55	Decapoda	Palaemonidae	<i>Leander sp.1</i>	P	Ma	
55	Amphipoda	Liljeborgiidae	<i>Listriella sp.</i>	P	Ma	
55	Mysida	Mysidae	<i>Metamysidopsis pacifica</i> Zimmer	P	Ma	Order Mysidacea in (55)
55	Stomatopoda	Nannosquillidae	<i>Nannosquilla decemspinosa</i> (Rathbun, 1910)	P	Ma	
55	Amphipoda	Talitridae	<i>Orchestoidea biolleyi</i> Stebbing	P	Ma	
55	Decapoda	Palaemonidae	<i>Palaemon sp.1</i>	P	Ma	
55	Amphipoda	Phoxocephalidae	<i>Paraphoxus obtusidens</i>	P	Ma	
55	Amphipoda	Phoxocephalidae	<i>Platyischnopus sp.</i>	P	Ma	
55	Decapoda	Raninidae	<i>Raninoides benedicti</i> Rathbun	P	Ma	
55	Amphipoda	Aoridae	<i>Rudilemboies sp.</i>	P	Ma	
55	Stomatopoda	Squillidae	<i>Squilla aculeata</i> Bigelow	P	Ma	
49	Decapoda	Alpheidae	<i>Synalpheus charon</i> (Heller, 1861)	P	Ma	Pacific entrances to the Canal
55	Decapoda	Alpheidae	<i>Synalpheus sp.1</i>	P	Ma	Collected in Miraflores Locks
55	Decapoda	Ocypodidae	<i>Uca deichmanni</i> Rathbun	P	Ma	
55	Decapoda	Portunidae	<i>Euphyllax robustus</i>	P	Ma	
55	Decapoda	Penaeidae	<i>Farfantepenaeus brevirostris</i> (Kingsley, 1878)	P	Ma	
55	Decapoda	Penaeidae	<i>Litopenaeus vannamei</i> (Boone, 1931)	P	Ma	
55	Decapoda	Portunidae	<i>Portunus xanthusii</i> (Stimpson, 1860)	P	Ma	
55	Isopoda	Cirolanidae	<i>Exciorlana brasiliensis</i> Richardson	P, A	Ma	
41	Isopoda	Limnoriidae	<i>Limnoria tripunctata</i> Menzies	P, A	Ma	This species can tolerate salinidades falls of 20 o/oo
55	Isopoda	Sphaeromatidae	<i>Serolis tropica</i> Glynn	P, A	Ma	
84	Decapoda	Penaeidae	<i>Litopenaeus occidentalis</i> (Streets, 1871)	P, ML	Ma	Collected in Miraflores Locks
84	Decapoda	Penaeidae	<i>Litopenaeus stylirostris</i> (Stimpson, 1874)	P, ML	Ma	Blue shrimp. Collected in Miraflores Locks.
49	Decapoda	Majidae	<i>Notolopas lamelatus</i> Stimpson	P, ML	Ma	Collected in Miraflores Locks.
49	Decapoda	Majidae	<i>Pelia pacifica</i> A. Milne Edwards	P, ML	Ma	Collected in Miraflores Locks.
55, 49	Decapoda	Portunidae	<i>Callinectes arcuatus</i> Ordway	P, PDML	Ma	
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium digueti</i> Bouvier	PDM, M	Fr	
CRUSTACEANS						
CRUSTACEANS/CRABS						
49	Decapoda	Grapsidae	<i>Sesarma angustum</i>	P	Ma	
55	Decapoda	Grapsidae	<i>Sesarma sp.1</i>	P	Ma	
49	Decapoda	Grapsidae	<i>Sesarma occidentale</i> Smith	M	Ma	
49	Decapoda	Grapsidae	<i>Sesarma americanum</i>	G	Fr	
49	Decapoda	Grapsidae	<i>Sesarma rhizophorae</i> Rathbun	G	Ma	
UP/ACP	Decapoda	Gecarcinidae	<i>Cardisoma guanhumi</i> Latreille	G	T, Ma	Blue land crab
55, 49	Decapoda	Portunidae	<i>Callinectes danae</i> Smith, 1869	A, GL	Ma	Gatun Locks. Dana swimming crab
Planktonic Crustaceans						
CLADOCERA						
7, 22, 44	Diplostraca	Bosminidae	<i>Bosminopsis deitersi</i> Richard, 1895	G, M	Fr	
7, 22, 44	Diplostraca	Bosminidae	<i>Bosmina longirostris</i> (O. F. Mueller, 1785)	G	Fr	Abundant in open areas in Gatún Lake. Form part of fresh water zooplankton.
44	Diplostraca	Bosminidae	<i>Bosmina longispina</i> Leydig, 1860	G	Fr	
44	Diplostraca	Chydoridae	<i>Alona affinis</i> (Leydig, 1860)	G	Fr	
44	Diplostraca	Chydoridae	<i>Alona rectangula</i> Sars, 1861	G, M	Fr	
44	Diplostraca	Chydoridae	<i>Dunhevedia setigera</i> (Birge, 1877)	G	Fr	
44	Diplostraca	Chydoridae	<i>Chydorus eurynotus</i> Sars	G	Fr	
44	Diplostraca	Chydoridae	<i>Chydorus sphaericus</i> (O. F. Mueller, 1785)	G	Fr	
44	Diplostraca	Chydoridae	<i>Euryalona occidentalis</i> Sars 1901	M	Fr	
44	Diplostraca	Chydoridae	<i>Leydigia acanthocercoides</i> (Fischer, 1854)	M	Fr	
44	Diplostraca	Chydoridae	<i>Dadaya macrops</i> (Daday, 1898)	M	Fr	
22, 44	Diplostraca	Daphniidae	<i>Moina micrura</i> Kurz, 1874	G, M	Fr	

Table 2-4 A. List of Invertebrates Reported in Gatún and Miraflores Lakes, Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
7, 22, 44	Diplostraca	Daphniidae	<i>Moina minuta</i> Hansen, 1899	G, M	Fr	
7, 9, 22, 44	Diplostraca	Daphniidae	<i>Ceriodaphnia cornuta</i> Sars, 1885	G	Fr	Abundant in open areas in Gatún Lake. Form part of fresh water zooplankton.
22, 44	Diplostraca	Daphniidae	<i>Simocephalus exspinosis</i> (Koch, 1841)	M	Fr	
44	Diplostraca	Daphniidae	<i>Simocephalus serrulatus</i> (Koch, 1841)	M	Fr	
44	Diplostraca	Macrothricidae	<i>Ilyocryptus spinifer</i> Herrick 1882	G, M	Fr	
44	Diplostraca	Macrothricidae	<i>Macrothrix rosea</i> (Jurine, 1820)	G, M	Fr	
44	Diplostraca	Macrothricidae	<i>Grimaldina brazzae</i> Richard, 1892	M	Fr	
7, 22, 44	Diplostraca	Sididae	<i>Diaphanosoma brachyurum</i> (Lievin, 1848)	G, M	Fr	Abundant in open areas in Gatún Lake. Form part of fresh water zooplankton.
COPEPODS						
22	Calanoida	Pseudodiaptomidae	<i>Pseudodiaptomus cokeri</i> Gonzalez & Bowman	A	Ma	
22	Calanoida	Pontellidae	<i>Calanopia americana</i> DahlF	A	Ma	
22	Calanoida	Tortanidae	<i>Tortanus sp.</i>	A	Ma	
22	Calanoida	Acartiidae	<i>Acartia spinata</i> Esterly	A	Ma	
22, 31	Calanoida	Acartiidae	<i>Acartia tonsa</i> Dana	A, P	Ma	
22	Calanoida	Acartiidae	<i>Acartia lilljeborgii</i> Giesbrecht	A, P	Ma	
22	Calanoida	Paracalanidae	<i>Paracalanus crassirostris</i> DahlF	A, P	Ma	
22	Cyclopoida	Oithonidae	<i>Oithona hebes</i> Giesbrecht	A, P	Ma	
22	Cyclopoida	Oithonidae	<i>Oithona oculata</i> Farran	A, P	Ma	
22	Cyclopoida	Oithonidae	<i>Oithona nana</i> Giesbrecht	A, P	Ma	
22	Harpacticoida	Euterpinidae	<i>Euterpina acutifrons</i> (Dana) 1847	A, P	Ma	
44, 1	Calanoida	Diaptomidae	<i>Diaptomus marshi</i> Juday	G	Fr	
44	Cyclopoida	Cyclopidae	<i>Eucyclops agilis</i> (Koch) 1838	G	Fr	
22, 44, 1	Calanoida	Diaptomidae	<i>Diaptomus leoninicollinus</i> Marsh	G	Fr	Abundant in open areas in Gatún Lake. Form part of fresh water zooplankton.
9, 44, 1	Calanoida	Diaptomidae	<i>Diaptomus gatunensis</i> Marsh	G, M	Fr	
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops albidus</i> Jurine	G, M	Fr	
44	Cyclopoida	Cyclopidae	<i>Cyclops dentimanus</i> Marsh	G, M	Fr	
22, 44, 1	Cyclopoida	Cyclopidae	<i>Cyclops leuckarti</i> Claus	G, M	Fr	
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops serrulatus</i> Fischer	G, M	Fr	
22, 44	Cyclopoida	Cyclopidae	<i>Cyclops tenuis</i> Marsh	G, M	Fr	Abundant in open areas in Gatún Lake. Form part of fresh water zooplankton.
44	Cyclopoida	Cyclopidae	<i>Cyclops ater</i> Herrick	M	Fr	
22, 44, 1	Cyclopoida	Cyclopidae	<i>Cyclops panamensis</i> Marsh	M	Fr	
44	Cyclopoida	Cyclopidae	<i>Cyclops phaleratus</i> Koch	M	Fr	
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops prasinus</i> Fischer	M	Fr	
22, 44, 1	Calanoida	Pseudodiaptomidae	<i>Pseudodiaptomus culebreensis</i> Marsh	M, P	Fr	
22	Calanoida	Pseudodiaptomidae	<i>Pseudodiaptomus wrighti</i> JohnsonMW	P	Ma	
22	Cyclopoida	Oithonidae	<i>Oithona simplex</i> Farran	P	Ma	
22	Cyclopoida	Oithonidae	<i>Oithona sp.</i>	P	Ma	
Rotifers						
9	Ploima	Brachionidae	<i>Keratella sp.</i>	G	Fr	
9	Ploima	Trichocercidae	<i>Trichocerca sp.</i>	G	Fr	
9	ploima	Brachionidae	<i>Brachionus sp.</i>	G	Fr	
9	Flosculariaceae	Filiniidae	<i>Filinia sp.</i>	G	Fr	
9	Ploima	Asplanchnidiae	<i>Asplanchna sp.</i>	G	Fr	
9	Bdelloidea	Philodinidae	<i>Philodina sp.</i>	G	Fr	

A= Atlantic or Caribbean entrance of the Panama Canal; P=Pacific entrance of the Panama Canal; G=Gatun Lake

M=Miraflores Lake; PDM=Pedro Miguel Locks

Fr=Freshwater; Ma=Marine; T= Terrestrial; B= Benthos

Table 2-4 B. List of Marine Fishes Reported to Gatún, Miraflores Lakes Miraflores and the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Anguilliformes	Congridae	<i>Ariosoma baleanicum</i> (Delaroche, 1809)	A	Ma	Bandtooth conger.
55	Anguilliformes	Moringuidae	<i>Neoconger vermicularis</i> Gilbert	P	Ma	
55	Anguilliformes	Muraenidae	<i>Gymnothorax funebris</i> Ranzani, 1840	A	Ma	Green moray.
55	Anguilliformes	Ophichthidae	<i>Ahlia egmontis</i> (Jordan, 1884)	A	Ma	Key worm eel.
55	Anguilliformes	Ophichthidae	<i>Bascanichthys scuticaris</i> (Goode & Bean, 1880)	A	Ma	Whip eel.
55	Anguilliformes	Ophichthidae	<i>Myrophis punctatus</i> Lütken, 1852	A	Ma	Reported from fresh water in Nicaragua, Costa Rica, and Mexico. Speckled worm eel
55	Anguilliformes	Ophichthidae	<i>Ophichthus triserialis</i> (Kaup, 1856)	P	Ma	Pacific snake-eel. Inhabits sandy and muddy bottoms.
55	Anguilliformes	Ophichthidae	<i>Ophichthus zophochir</i> Jordan & Gilbert, 1882	P	Ma	Collected in depths <200 m. Yellow snake-eel
55	Anguilliformes	Serrivomeridae	<i>Serrivomer sector</i> Garman, 1899	P	Ma	Collected in depths <200 m. Sawtooth eel
55	Anguilliformes	Serrivomeridae	<i>Serrivomer sp.</i>	P	Ma	Collected in depths <200 m.
55	Anguilliformes	Muraenesicidae	<i>Cynoponticus coniceps</i> Jordan & Gilbert	P	Ma	Collected in depths <50 m. Red pike-conger
55	Atheriniformes	Atherinidae	<i>Atherinomorus stipes</i> (Müller & Troschel, 1848)	A	Ma	Hardhead silverside.
55	Atheriniformes	Atherinopsidae	<i>Atherinella pachylepis</i> (Günther, 1864)	P	Ma	Thickscale silverside.
55	Atheriniformes	Atherinopsidae	<i>Atherinella panamensis</i> Steindachner, 1875	P	Ma	Panama silverside.
55	Aulopiformes	Synodontidae	<i>Saurida brasiliensis</i> Norman, 1935	A	Ma	Brazilian lizardfish.
55	Aulopiformes	Synodontidae	<i>Synodus evermanni</i> Jordan & Bollman, 1890	P	Ma	Found on soft bottoms. Inotted lizardfish.
						Found inshore in saltwater creeks, rivers, bays, sounds (Ref. 39156), and deep channels within lagoons. Probably more dense over mud than shell or calcareous bottom. Inshore lizardfish.
55	Aulopiformes	Synodontidae	<i>Synodus foetens</i> (Linnaeus, 1766)	A	Ma	
55	Aulopiformes	Synodontidae	<i>Synodus poeyi</i> Jordan, 1887	A	Ma	Offshore lizardfish.
55	Aulopiformes	Synodontidae	<i>Synodus scituliceps</i> Jordan & Gilbert, 1882	P	Ma	A very common species found on soft bottom. Shorthead lizardfish
55	Aulopiformes	Synodontidae	<i>Synodus sp.</i>	A	Ma	
55	Batrachoidiformes	Batrachoididae	<i>Batrachoides pacifici</i> (Günther, 1861)	P	Ma	Reported to Eastern Pacific: Panama Canal to northern Peru. Sometimes enters fresh water. Pacific toadfish.
55	Batrachoidiformes	Batrachoididae	<i>Amphichthys cryptocentrus</i> (Valenciennes, 1837)	A	Ma	Bocon toadfish.
55	Batrachoidiformes	Batrachoididae	<i>Daector dowi</i> (Jordan & Gilbert, 1887)	P	Ma	Occurs in shallow waters. Dow's toadfish.
55	Batrachoidiformes	Batrachoididae	<i>Daector reticulata</i> (Günther, 1864)	P	Ma	Inhabits shallow waters. Reticulated toadfish.
55	Batrachoidiformes	Batrachoididae	<i>Porichthys greeni</i> Gilbert & Starks, 1904	P	Ma	Found in shallow waters up to depths of 27 m. Greene's midshipman.
55	Batrachoidiformes	Batrachoididae	<i>Porichthys margaritatus</i> (Richardson, 1844)	P	Ma	Inhabits offshore, soft bottom habitats. Daisy midshipman.
55	Batrachoidiformes	Batrachoididae	<i>Porichthys pauciradiatus</i> Caldwell & Caldwell, 1963	A	Ma	
55	Batrachoidiformes	Batrachoididae	<i>Sanopus barbatus</i> (Meek & Hildebrand, 1928)	A	Ma	Bearded toadfish.
55	Batrachoidiformes	Batrachoididae	<i>Thalassophryne megalops</i> Bean & Weed, 1910	A	Ma	
55	Beloniformes	Belonidae	<i>Strongylura timucu</i> (Walbaum, 1792)	A	Ma	Adults found on reef flats, in lagoons, or in freshwater. Timucu.
55	Beloniformes	Exocoetidae	<i>Parexocoetus brachypterus</i> (Richardson, 1846)	A	Ma	Sailfin flyingfish.
55	Beloniformes	Hemiramphidae	<i>Hyporamphus unifasciatus</i> (Ranzani, 1842)	A	Ma	Common halfbeak.
55	Beryciformes	Holocentridae	<i>Myripristis jacobus</i> Cuvier, 1829	A	Ma	Blackbar soldierfish.
55	Beryciformes	Holocentridae	<i>Sargocentron bullisi</i> (Woods, 1955)	A	Ma	Deepwater squirrelfish.
55	Beryciformes	Holocentridae	<i>Sargocentron sp.</i>	A	Ma	
55	Clupeiformes	Clupeidae	<i>Harengula humeralis</i> (Cuvier, 1829)	A	Ma	Redear herring.
55	Clupeiformes	Clupeidae	<i>Harengula sp.</i>	A	Ma	
55	Clupeiformes	Clupeidae	<i>Lile stolifera</i> (Jordan & Gilbert, 1882)	P	Ma	Pacific piquitinga.
55	Clupeiformes	Clupeidae	<i>Odontognathus compressus</i> Meek & Hildebrand, 1923	A	Ma	Caribbean longfin herring.
55	Clupeiformes	Clupeidae	<i>Opisthonema libertate</i> (Günther, 1867)	P	Ma	Occur near the surface of coastal and offshore waters. Pacific thread herring
55	Clupeiformes	Clupeidae	<i>Opisthonema oglinum</i> (Lesueur, 1818)	A	Ma	Occur in freshwater in St. Johns River, Florida. Atlantic thread herring.
55	Clupeiformes	Clupeidae	<i>Opisthonema sp.</i>	A	Ma	
55	Clupeiformes	Clupeidae	<i>Opisthophterus dovi</i> (Günther, 1868)	A	Ma	Dove's longfin herring.
55	Clupeiformes	Engraulidae	<i>Anchoa exigua</i> (Jordan & Gilbert, 1882)	P	Ma	Occurs in coastal waters, probably not entering estuaries. Slender anchovy.
55	Clupeiformes	Engraulidae	<i>Anchoa hepsetus</i> (Linnaeus, 1758)	A	Ma	Able to tolerate a wide range of salinities, from hypersaline to almost fresh, forms dense schools. Broad-striped anchovy.
55	Clupeiformes	Engraulidae	<i>Anchoa ischana</i> (Jordan & Gilbert, 1882)	P	Ma	Gulf of California slender anchovy. Occurring in coastal waters.
55	Clupeiformes	Engraulidae	<i>Anchoa lamprotaenia</i> Hildebrand, 1943	P, A	Ma	Occurs in coastal waters, forming dense schools. Big-eye anchovy
55	Clupeiformes	Engraulidae	<i>Anchoa lucida</i> (Jordan & Gilbert, 1882)	P	Ma	Occurs in coastal waters, but most often recorded from bays, lagoons and estuaries, thus able to tolerate lowered salinities. Forms schools. Bright anchovy.
55	Clupeiformes	Engraulidae	<i>Anchoa panamensis</i> (Steindachner, 1877)	P	Ma	Occurs in coastal waters, probably tolerating lowered salinities. Panama anchovy.
55	Clupeiformes	Engraulidae	<i>Anchoa sp.</i>	A	Ma	Peripheral specie.
55	Clupeiformes	Engraulidae	<i>Anchoa argentivittata</i> (Regan, 1904)	P	Ma	Regan's anchovy. Found in coastal waters.
55	Clupeiformes	Engraulidae	<i>Anchovia sp.</i>	P	Ma	
55	Clupeiformes	Engraulidae	<i>Cetengraulis mysticetus</i> (Günther, 1867)	P	Ma	Occurs inshore, principally over mud flats. Pacific anchoveta
55	Clupeiformes	Engraulidae	<i>Lycengraulis poeyi</i> (Kner, 1863)	P	Ma	Occurs inshore but entering brackish if not fresh water. Pacific sabretooth anchovy
55	Cyprinodontiformes	Poeciliidae	<i>Poeciliopsis elongata</i> (Günther, 1866)	P	Ma	In estuaries and brackish river mouths. Elongate toothcarp.
55	Elopiformes	Albulidae	<i>Albula vulpes</i> (Linnaeus, 1758)	P, A	Ma	Collected in depths <50 m. Bonefish

Table 2-4 B. List of Marine Fishes Reported to Gatún, Miraflores Lakes Miraflores and the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
86, 71	Elopiformes	Albulidae	<i>Megalops atlanticus</i> Valenciennes, 1847	P, A, G	Ma	Inhabit coastal waters, bays, estuaries. Peripheral
51	Elopiformes	Elopidae	<i>Elops affinis</i> Regan, 1909	G, P	Ma	Pacific ladyfish. Peripheral specie.
55	Gadiformes	Bregmacerotidae	<i>Bregmaceros atlanticus</i> Goode & Bean, 1886	A	Ma	Antenna codlet.
55	Gobiesociformes	Gobiesocidae	<i>Gobiesox adustus</i> Jordan & Gilbert, 1882	A	Ma	Panamic clingfish.
55	Lophiiformes	Lophiidae	<i>Lophiomus setigerus</i> (Vahl, 1797)	P	Ma	Found on sandy mud bottom. Blackmouth angler.
55	Lophiiformes	Ogcocephalidae	<i>Halieutichthys aculeatus</i> (Mitchill, 1818)	A	Ma	Pancake batfish.
55	Lophiiformes	Ogcocephalidae	<i>Ogcocephalus nasutus</i> (Cuvier, 1829)	A	Ma	Shortnose batfish.
55	Lophiiformes	Ogcocephalidae	<i>Zalieutes elater</i> (Jordan & Gilbert, 1882)	P	Ma	Found on sand bottom. Roundel batfish.
55	Lophiiformes	Antennariidae	<i>Antennarius sanguineus</i> Gill, 1863	P	Ma	Found on small recesses in rocky reefs. Bloody frogfish.
55	Lophiiformes	Antennariidae	<i>Antennarius striatus</i> (Shaw, 1794)	A	Ma	Striated frogfish.
55	Myctophiformes	Myctophidae	<i>Gonichthysocco</i> (Cocco, 1829)	P	Ma	Oceanic, was collected in deeps of 50 m (55).
55	Myctophiformes	Myctophidae	<i>Myctophum affine</i> (Lütken, 1892)	A	Ma	Metallic lantern fish.
55	Myctophiformes	Myctophidae	<i>Myctophum nitidulum</i> Garman, 1899	A	Ma	Pearly lanternfish.
55	Ophidiiformes	Bythitidae	<i>Ogilbia cayorum</i> Evermann & Kendall, 1898	A	Ma	Key brotula.
55	Ophidiiformes	Bythitidae	<i>Ogilbia sp.</i>	A	Ma	
55	Ophidiiformes	Ophidiidae	<i>Lepophidium prorates</i> (Jordan & Bollman, 1890)	P	Ma	Prowspine cusk eel.
55	Ophidiiformes	Ophidiidae	<i>Brotula sp.</i>	P	Ma	
55	Ophidiiformes	Ophidiidae	<i>Lepophidium brevibarbe</i> (Cuvier, 1829)	A	Ma	Shortbeard cusk-eel.
55	Perciformes	Apogonidae	<i>Apogon quadrisquamatus</i> Longley, 1934	A	Ma	Sawcheek cardinalfish.
55	Perciformes	Apogonidae	<i>Phaeoptyx pigmentaria</i> (Poey, 1860)	A	Ma	Dusky cardinalfish.
94	Perciformes	Blenniidae	<i>Hypseurochilus aequipinnis</i> (Günther, 1861)	A, M	Ma	This species was collected in the Miraflores Locks.
94	Perciformes	Blenniidae	<i>Lupinoblennius dispar</i> Herre, 1942	M, P	Ma	This species migrated from the atlantic side.
94	Perciformes	Blenniidae	<i>Omobranchus punctatus</i> (Valenciennes, 1836)	P, A	Ma	This especies crossed the canal to the atlantic side.
55	Perciformes	Callionymidae	<i>Callionymus bairdi</i> Jordan, 1888	A	Ma	Lancer dragonet.
55	Perciformes	Carangidae	<i>Alectis ciliaris</i> (Bloch, 1787)	P	Ma	African pompano
55	Perciformes	Carangidae	<i>Carangoides ruber</i> (Bloch, 1793)	A	Ma	Bar jack.
55	Perciformes	Carangidae	<i>Caranx cryos</i> (Mitchill, 1815)	A	Ma	Blue runner.
55	Perciformes	Carangidae	<i>Caranx hippos</i> (Linnaeus, 1766)	P	Ma	Crevalle jack
55	Perciformes	Carangidae	<i>Caranx latus</i> Agassiz, 1831	A	Ma	Horse-eye jack.
55	Perciformes	Carangidae	<i>Caranx marginatus</i> Gill	P	Ma	
55	Perciformes	Carangidae	<i>Chloroscombrus chrysurus</i> (Linnaeus, 1766)	A	Ma	Atlantic bumper.
55	Perciformes	Carangidae	<i>Chloroscombrus orquaeta</i> Jordan & Gilbert, 1883	P	Ma	Pacific bumper.
55	Perciformes	Carangidae	<i>Decapterus punctatus</i> (Cuvier, 1829)	A	Ma	Round scad.
94	Perciformes	Carangidae	<i>Gnathanodon speciosus</i> (Forsskål, 1775)	P, A	Ma	Was collected in the lower gatun lock.
55	Perciformes	Carangidae	<i>Hemicaranx zelotes</i> Gilbert, 1898	P	Ma	Found in coastal waters and penetrates brackish waters. Blackfin jack.
55	Perciformes	Carangidae	<i>Hemicaranx atrimanus</i> (Jordan & Gilbert, 1882)	A	Ma	
55	Perciformes	Carangidae	<i>Hemicaranx rhomboides</i> Meek & Hildebrand	A	Ma	
55	Perciformes	Carangidae	<i>Oligoplites altus</i> (Günther, 1868)	P	Ma	Longjaw leatherjack.
55	Perciformes	Carangidae	<i>Oligoplites saurus</i> (Bloch & Schneider, 1801)	A, M	Ma	Found inshore, usually along sandy beaches, in bays and inlets, enters estuaries and fresh water and prefers turbid water. Leatherjack. Peripheral specie
55	Perciformes	Carangidae	<i>Oligoplites mundus</i> (Günther, 1868)	P	Ma	
55	Perciformes	Carangidae	<i>Selar crumenophthalmus</i> (Bloch, 1793)	P	Ma	Bigeye scad.
55	Perciformes	Carangidae	<i>Selene brevoortii</i> (Gill, 1863)	P	Ma	A pelagic and demersal species found in shallow coastal waters. Mexican lookdown.
55	Perciformes	Carangidae	<i>Selene orstedii</i> Lütken, 1880	P	Ma	Mexican moonfish.
55	Perciformes	Carangidae	<i>Selene peruviana</i> (Guichenot, 1866)	P	Ma	Pacific moonfish.
55	Perciformes	Carangidae	<i>Selene setapinnis</i> (Mitchill, 1815)	A	Ma	Atlantic moonfish.
55	Perciformes	Carangidae	<i>Trachinotus falcatus</i> (Linnaeus, 1758)	A	Ma	Permit.
55	Perciformes	Carangidae	<i>Trachinotus rhodopus</i> (Gill, 1863)	P	Ma	Gafftopsail pompano.
62	Perciformes	Eleotridae	<i>Butis koiliomatodon</i> (Bleeker, 1849)	M, P	Ma, Fr	Demersal, freshwater, brackish and marine environment. This a exotic species from Indo-Pacific: Delagoa Bay, Mozambique and Madagascar to China and Philippines maybe introduced by ballast water.
62	Perciformes	Eleotridae	<i>Eleotris picta</i> Kner & Steindachner, 1863	M, P	Ma, Fr	Demersal; catadromous, freshwater; brackish; marine environments. Appears to prefer estuarine freshwater tributaries, occurring in waters with a salinity range of 0 to 19 ppt. Spinycheek sleeper
62	Perciformes	Eleotridae	<i>Eleotris pisonis</i> (Gmelin, 1789)	M, P	Ma, Fr	Demersal; freshwater; brackish waters. More abundant near the coast and only large individuals are found upstream. Spotted sleeper
62	Perciformes	Eleotridae	<i>Eretelis armiger</i> (Jordan & Richardson, 1895)	M, P	Ma	Demersal and marine environments.
55	Perciformes	Ephippidae	<i>Chaetodipterus zonatus</i> (Girard, 1858)	P	Ma	Pacific spadefish.
55	Perciformes	Gerreidae	<i>Diapterus auratus</i> Ranzani, 1842	A	Ma	Irish mojarra.
55, UP-ACP04	Perciformes	Gerreidae	<i>Diapterus peruvianus</i> (Cuvier, 1830)	G, P, M	Ma	Peruvian mojarra.
55	Perciformes	Gerreidae	<i>Diapterus rhombeus</i> (Cuvier, 1829)	A	Ma	Common in mangrove-lined lagoons and the Juveniles common in hypersaline lagoons and in brackish water. Caitipa mojarra. Peripheral specie.

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SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Perciformes	Gerreidae	<i>Eucinostomus argenteus</i> Baird & Girard, 1855	A	Ma	Enters freshwater and the juveniles are encountered in lagoons of mangroves. Silver mojarra.
UP-ACP04	Perciformes	Gerreidae	<i>Eucinostomus gracilis</i> (Gill, 1862)	M, P		Coastal waters, especially abundant in brackish waters. Peripheral specie. Graceful mojarra
55	Perciformes	Gerreidae	<i>Eucinostomus gula</i> (Quoy & Gaimard, 1824)	A	Ma	Enters fresh water in limestone regions. Jenny mojarra.
55	Perciformes	Gerreidae	<i>Eucinostomus jonesii</i> (Günther, 1879)	A	Ma	Slender mojarra.
55	Perciformes	Gerreidae	<i>Eucinostomus californiensis</i> (Gill, 1862)	P	Ma	Tentative position in taxonomy.
55	Perciformes	Gerreidae	<i>Eucinostomus californiensis elongatus</i> Meek & Hildebrand	P	Ma	
51	Perciformes	Gerreidae	<i>Eugerres brevimanus</i> (Günther, 1864)	G, P	Ma	Inhabits coastal waters and lagoons. Short fin mojarra
51	Perciformes	Gerreidae	<i>Eugerres lineatus</i> (Humboldt, 1821)	G, P	Ma	Streaked mojarra.
51	Perciformes	Gerreidae	<i>Eugerres plumieri</i> (Cuvier, 1830)	G	Ma	Often entering a considerable distance into freshwaters. Inhabits shallow coastal waters and common in brackish waters. Striped mojarra
55	Perciformes	Gerreidae	<i>Gerres cinereus</i> (Walbaum, 1792)	G, P, A, M	Ma	Yellow fin mojarra. Peripheral.
94	Perciformes	Gobiidae	<i>Barbulifer ceuthoeucus</i> (Jordan & Gilbert, 1884)	P, A	Ma	Collected in the bay of Panama, crossed the Canal trough water ballast.
55	Perciformes	Gobiidae	<i>Bathygobius soporator</i> (Valenciennes, 1837)	P, A	Ma	Frillfin goby.
55	Perciformes	Gobiidae	<i>Bollmannia boqueronensis</i> Evermann & Marsh, 1899	A	Ma	White-eye goby.
55	Perciformes	Gobiidae	<i>Bollmannia sp.</i>	A	Ma	
55	Perciformes	Gobiidae	<i>Ctenogobius sagittula</i> (Günther, 1861)	P, M	Ma	Longtail goby. Peripheral specie.
55	Perciformes	Gobiidae	<i>Gnatholepis thompsoni</i> Jordan, 1904	A	Ma	Goldspot goby.
73	Perciformes	Gobiidae	<i>Lophogobius cristulatus</i> Ginsburg, 1939	P	Ma	
73, 94	Perciformes	Gobiidae	<i>Lophogobius cyprinoides</i> (Pallas, 1770)	A, M	Ma	Was reported by Rubinoff in Miraflores third Locks. Euryhaline specie
55	Perciformes	Gobiidae	<i>Microgobius erectus</i> Ginsburg, 1938	P	Ma	Erect goby.
UP-ACP04	Perciformes	Gobiidae	<i>Parrella lucretiae</i> (Eigenmann & Eigenmann, 1888)	G, M, P	Ma, Br	Lucretiae's goby. Inhabits shallow bays and estuaries. Peripheral specie.
55	Perciformes	Haemulidae	<i>Anisotremus pacifici</i> (Günther, 1864)	P	A	Carruco sargo.
55	Perciformes	Haemulidae	<i>Haemulon aurolineatum</i> Cuvier, 1830	A	Ma	Tomtate grunt.
55	Perciformes	Haemulidae	<i>Haemulon bonariense</i> Cuvier, 1830	A	Ma	Black grunt.
55	Perciformes	Haemulidae	<i>Haemulon plumieri</i> (Lacepède, 1801)	A	Ma	Grunt.
55	Perciformes	Haemulidae	<i>Haemulon sexfasciatum</i> Gill, 1862	P	Ma	Greybar grunt
55	Perciformes	Haemulidae	<i>Haemulon steindachneri</i> (Jordan & Gilbert, 1882)	A	Ma	Chere-chere grunt.
55	Perciformes	Haemulidae	<i>Haemulon sp.</i>	A	Ma	
55	Perciformes	Haemulidae	<i>Haemulopsis leuciscus</i> (Günther, 1864)	P	Ma	Inhabits coastal seas on sandy or muddy bottoms and found in estuaries. White grunt.
55	Perciformes	Haemulidae	<i>Orthopristis chalceus</i> (Günther, 1864)	P	Ma	Brassy grunt.
55	Perciformes	Haemulidae	<i>Orthopristis sp.</i>	P	Ma	
55	Perciformes	Haemulidae	<i>Pomadasys bayanus</i> Jordan & Evermann, 1898	P	Fr	Confined to fresh waters, ascending rivers with moderate currents. Purplemouth grunt.
55	Perciformes	Haemulidae	<i>Pomadasys corvinaeformis</i> (Steindachner, 1868)	A	Ma	Inhabits coastal waters, over sandy or rocky bottoms. Also found in water with low salinity. Roughneck grunt.
55	Perciformes	Haemulidae	<i>Pomadasys croco</i> (Cuvier, 1830)	A	Ma	Inhabits rivers and creeks of low to high current velocity, also in brackish mangrove-lined lagoons. Burro grunt.
55	Perciformes	Haemulidae	<i>Pomadasys macracanthus</i> (Günther, 1864)	P	Ma	Found near the littoral zone of coastal waters and penetrates estuaries. Longspine grunt.
55	Perciformes	Haemulidae	<i>Pomadasys panamensis</i> (Steindachner, 1876)	P	Ma	Inhabits sandy bottoms of coastal waters. Panama grunt.
55	Perciformes	Labridae	<i>Doratonotus megalepis</i> Günther, 1862	A	Ma	Dwarf wrasse.
55	Perciformes	Labridae	<i>Halichoeres sp.</i>	A	Ma	
55	Perciformes	Labridae	<i>Thalassoma bifasciatum</i> (Bloch, 1791)	A	Ma	Bluehead.
55	Perciformes	Lutjanidae	<i>Lutjanus analis</i> (Cuvier, 1828)	A	Ma	Mutton snapper.
55	Perciformes	Lutjanidae	<i>Lutjanus apodus</i> (Walbaum, 1792)	A	Ma	Schoolmaster snapper.
UP-ACP04, 51	Perciformes	Lutjanidae	<i>Lutjanus argentiventralis</i> (Peters, 1869)	M, P	Ma, Br	Tolerant to freshwaters and Found in inshore reef areas over hard bottoms until at least 60 m depth. Yellow snapper. Peripheral specie.
UP-ACP04	Perciformes	Lutjanidae	<i>Lutjanus colorado</i> Jordan & Gilbert, 1882	M, P	Ma	reef-associated; brackish; marine environment. Peripheral specie. Colorado snapper.
55	Perciformes	Lutjanidae	<i>Lutjanus jocu</i> (Bloch & Schneider, 1801)	A	Ma	Young found in estuaries and occasionally enters rivers. Dog snapper.
55	Perciformes	Lutjanidae	<i>Lutjanus mahogoni</i> (Cuvier, 1828)	A	Ma	Mahogany snapper.
55	Perciformes	Lutjanidae	<i>Lutjanus synagris</i> (Linnaeus, 1758)	A	Ma	Lane snapper.
55	Perciformes	Lutjanidae	<i>Lutjanus guttatus</i> (Steindachner, 1869)	P	Ma	Juveniles inhabit estuaries and mouths of rivers. Spotted rose snapper.
55	Perciformes	Lutjanidae	<i>Ocyurus chrysurus</i> (Bloch, 1791)	A	Ma	Yellowtail snapper.
55	Perciformes	Lutjanidae	<i>Pristipomoides freemani</i> Anderson, 1966	A	Ma	Slender wenčhaman.
55	Perciformes	Lutjanidae	<i>Rhomboptilus aurorubens</i> (Cuvier, 1829)	A	Ma	Vermilion snapper.
55	Perciformes	Mugilidae	<i>Liza dumerili</i> (Steindachner, 1870)	A	Ma	Grooved mullet.
55, 51	Perciformes	Mugilidae	<i>Mugil curema</i> Valenciennes, 1836	P	Ma	Sometimes penetrates rivers. White mullet.
55	Perciformes	Mugilidae	<i>Mugil incilis</i> Hancock, 1830	A	Ma	Demersal, brackish and marine habits. Parassi mullet.
55	Perciformes	Mullidae	<i>Mulloidichthys martinicus</i> (Cuvier, 1829)	A	Ma	Yellow goatfish.

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55	Perciformes	Mullidae	<i>Pseudupeneus maculatus</i> (Bloch, 1793)	A	Ma	Spotted goatfish.
55	Perciformes	Mullidae	<i>Pseudupeneus grandisquamis</i> (Gill, 1863)	P	Ma	Bigscale goatfish.
55	Perciformes	Mullidae	<i>Upeneus parvus</i> Poey, 1852	A	Ma	Dwarf goatfish.
55	Perciformes	Nomeidae	<i>Psenes cyanophrys</i> Valenciennes, 1833	A	Ma	Freckled driftfish.
55	Perciformes	Ophichthidae	<i>Bascanichthys scuticaris</i> (Goode & Bean, 1880)	A	Ma	
55	Perciformes	Polynemidae	<i>Polydactylus approximans</i> (Lay & Bennett, 1839)	P	Ma	Blue bobo.
55	Perciformes	Polynemidae	<i>Polydactylus oligodon</i> (Günther, 1860)	A	Ma	Littlescale threadfin.
55	Perciformes	Polynemidae	<i>Polydactylus opercularis</i> (Gill, 1863)	P	Ma	Yellow bobo.
55	Perciformes	Polynemidae	<i>Polydactylus virginicus</i> (Linnaeus, 1758)	A	Ma	Also occurs in estuaries and hyper-saline lagoons. Barbu.
55	Perciformes	Priacanthidae	<i>Heteropriacanthus cruentatus</i> (Lacepede, 1801)	A	Ma	
55	Perciformes	Priacanthidae	<i>Priacanthus arenatus</i> Cuvier, 1829	A	Ma	Atlantic bigeye.
55	Perciformes	Scardidae	<i>Cryptotomus roseus</i> Cope, 1871	A	Ma	Bluelip parrotfish.
55	Perciformes	Sciaenidae	<i>Cynoscion albus</i> (Günther, 1864)	M, P	Ma	Inhabits coastal waters; juveniles entering estuaries, river mouths. Peripheral specie.
55	Perciformes	Sciaenidae	<i>Cynoscion leiarchus</i> (Cuvier, 1830)	A	Ma	Found over mud and sand bottoms in river estuaries to about 25 m depth. Smooth weakfish.
55	Perciformes	Sciaenidae	<i>Cynoscion phoxocephalus</i> Jordan & Gilbert, 1882	P	Ma	Inhabits coastal waters and estuaries with high salinities. Cachema weakfish.
55	Perciformes	Sciaenidae	<i>Cynoscion reticulatus</i> (Günther, 1864)	P	Ma	Striped weakfish.
55	Perciformes	Sciaenidae	<i>Larimus acclivis</i> Jordan & Bristol, 1898	P	Ma	Steeplined drum.
55	Perciformes	Sciaenidae	<i>Larimus argenteus</i> (Gill, 1863)	P	Ma	Silver drum.
55	Perciformes	Sciaenidae	<i>Larimus breviceps</i> Cuvier, 1830	A	Ma	Inhabits coastal waters and estuaries. Shorthead drum.
55	Perciformes	Sciaenidae	<i>Larimus effulgens</i> Gilbert, 1898	P	Ma	Shining drum.
55	Perciformes	Sciaenidae	<i>Macrodon ancax</i> (Jordan & Starks, 1904)	P	Ma	Inhabits coastal waters, bays, and estuaries. Dogteeth weakfish.
55	Perciformes	Sciaenidae	<i>Menticirrhus americanus</i> (Linnaeus, 1758)	A	Ma	Juveniles occur usually in water of lower salinity. Southern kingcroaker.
55	Perciformes	Sciaenidae	<i>Menticirrhus panamensis</i> (Steindachner, 1877)	P	Ma	Panama kingcroaker.
55	Perciformes	Sciaenidae	<i>Micropogonias altipinnis</i> (Günther, 1864)	P	Ma	Found along sandy shores and bays, also in estuaries and lagoons. Tallfin croaker.
55	Perciformes	Sciaenidae	<i>Ophioscion sigerus</i> (Jordan & Gilbert, 1884)	P	Ma	Point-Tuza croaker.
55	Perciformes	Sciaenidae	<i>Ophioscion simulus</i> Gilbert, 1898	P	Ma	Snub-nosed croaker.
55	Perciformes	Sciaenidae	<i>Stellifer fuerthii</i> (Steindachner, 1876)	P	Ma	White stardrum.
55	Perciformes	Sciaenidae	<i>Stellifer chrysoleuca</i> (Günther, 1867)	P	Ma	Shortnose stardrum.
55	Perciformes	Sciaenidae	<i>Umbrina coroides</i> Cuvier, 1830	A	Ma	Sand drum.
55	Perciformes	Sciaenidae	<i>Umbrina xanti</i> Gill, 1862	P	Ma	Polla drum.
55	Perciformes	Scombridae	<i>Scomber japonicus</i> Houttuyn, 1782	P	Ma	Chub mackerel.
55	Perciformes	Scombridae	<i>Scomberomorus maculatus</i> (Mitchill, 1815)	P	Ma	Spanish mackerel.
55	Perciformes	Serranidae	<i>Alphestes multiguttatus</i> (Günther, 1867)	P	Ma	Rivulated mutton hamlet
55	Perciformes	Serranidae	<i>Centristhmus signifer</i> Gilbert	P	Ma	
55	Perciformes	Serranidae	<i>Cephalopholis cruentata</i> (Lacepede, 1802)	A	Ma	Graysby.
55	Perciformes	Serranidae	<i>Diplectrum bivittatum</i> (Valenciennes, 1828)	A	Ma	Dwarf sand perch.
55	Perciformes	Serranidae	<i>Diplectrum euryplectrum</i> Jordan & Bollman, 1890	P	Ma	Bighead sand perch.
55	Perciformes	Serranidae	<i>Diplectrum formosum</i> (Linnaeus, 1766)	A	Ma	Sand seabass.
55	Perciformes	Serranidae	<i>Epinephelus labriformis</i> (Jenyns, 1840)	P	Ma	Starry grouper.
55	Perciformes	Serranidae	<i>Epinephelus niveatus</i> (Valenciennes, 1828)	P, A	Ma	Snowy grouper.
55	Perciformes	Serranidae	<i>Epinephelus acanthistius</i> (Gilbert, 1892)	P	Ma	Rooster hind.
55	Perciformes	Serranidae	<i>Epinephelus itajara</i> (Lichtenstein, 1822)	A	Ma	
55	Perciformes	Serranidae	<i>Epinephelus sp.</i>	P	Ma	
55	Perciformes	Serranidae	<i>Epinephelus striatus</i> (Bloch, 1792)	A	Ma	Rockfish.
55	Perciformes	Serranidae	<i>Epinephelus analogus</i> Gill, 1863	P	Ma	Spotted grouper.
55	Perciformes	Serranidae	<i>Mycteroperca interstitialis</i> (Poey, 1860)	A	Ma	Yellowmouth grouper.
55	Perciformes	Serranidae	<i>Rypticus nigripinnis</i> Gill, 1861	P	Ma	Blackfin soapfish.
55	Perciformes	Serranidae	<i>Rypticus sublateralis</i> Gill, 1861	A	Ma	Spotted soapfish.
55	Perciformes	Serranidae	<i>Serranus atrobranchus</i> (Cuvier, 1829)	A	Ma	Blackear bass.
55	Perciformes	Sparidae	<i>Calamus calamus</i> (Valenciennes, 1830)	A	Ma	Saucereye porgy.
55	Perciformes	Sparidae	<i>Calamus penna</i> (Valenciennes, 1830)	A	Ma	Sheepshead porgy.
55	Perciformes	Sphyraenidae	<i>Sphyraena barracuda</i> (Walbaum, 1792)	A	Ma	Reef-associated, brackish, marine habitats. Great barracuda
55	Perciformes	Sphyraenidae	<i>Sphyraena picudilla</i> Poey, 1860	A	Ma	Southern snett.
55	Perciformes	Stromateidae	<i>Archosargus rhomboidalis</i> (Linnaeus, 1758)	A	Ma	Western Atlantic seabream.
55	Perciformes	Stromateidae	<i>Peprilus palometa</i> Jordan & Bollman	P	Ma	
55	Perciformes	Trichiuridae	<i>Trichiurus lepturus</i> Linnaeus, 1758	P, A	Ma	Largehead hairtail.
55	Perciformes	Uranoscopidae	<i>Katetostoma averruncus</i> Jordan & Bollman, 1890	P	Ma	Smooth stargazer.
51	Perciformes	Centropomidae	<i>Centropomus armatus</i> Gill, 1863	G, P	Ma	Armed snook. Peripheral specie.
UP-ACP04	Perciformes	Centropomidae	<i>Centropomus medius</i> Günther, 1864	M, P	Ma	Blackfin snook. Enters freshwaters mostly in large rivers and feeds on fish and crustaceans.
UP-ACP04	Perciformes	Centropomidae	<i>Centropomus nigrescens</i> Günther, 1864	M, P	Br, Ma	occurs in estuaries and fresh water. Black snook.

Table 2-4 B. List of Marine Fishes Reported to Gatún, Miraflores Lakes Miraflores and the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
88	Perciformes	Centropomidae	<i>Centropomus parallelus</i> Poey, 1860	G	Ma	Inhabits coastal waters, estuaries and lagoons, penetrating into freshwater. Collected in Barro Colorado Island (BCI). Fat snook . Peripheral species
55	Perciformes	Centropomidae	<i>Centropomus robalito</i> Jordan & Gilbert, 1882	P	Ma	Mainly in estuaries but also enters freshwater to an elevation of 50 m. Yellowfin snook. Peripheral species
UP-ACP04	Perciformes	Centropomidae	<i>Centropomus viridis</i> Lockington, 1877	G	Ma	White snook.
55	Perciformes	Chaetodontidae	<i>Chaetodon humeralis</i> Günther, 1860	P	Ma	Threebanded butterflyfish.
55	Perciformes	Chaetodontidae	<i>Chaetodon ocellatus</i> Bloch, 1787	A	Ma	Spotfin butterflyfish.
55	Perciformes	Chaetodontidae	<i>Chaetodon selenus</i> Bleeker, 1853	A	Ma	Yellow-dotted butterflyfish.
55	Pleuronectiformes	Achiridae	<i>Achirus lineatus</i> (Linnaeus, 1758)	A	Ma	On sandy-muddy bottoms of estuaries and in the littoral zone. Lined sole.
55, UP-ACP04	Pleuronectiformes	Achiridae	<i>Achirus mazatlanus</i> (Steindachner, 1869)	P, G	Ma	Common in coastal waters less than 20 m depth and enters coastal lagoons and fresh water. Mazatlan sole.
55	Pleuronectiformes	Achiridae	<i>Gymnachirus melas</i> Nichols, 1916	A	Ma	North American naked sole.
55	Pleuronectiformes	Bothidae	<i>Bothus leopardinus</i> (Günther, 1862)	P	Ma	Pacific leopard flounder.
55	Pleuronectiformes	Bothidae	<i>Bothus ocellatus</i> (Agassiz, 1831)	A	Ma	Eyed flounder.
55	Pleuronectiformes	Bothidae	<i>Engyophrys sanctilaurentii</i> Jordan & Bollman, 1890	P	Ma	Speckled-tail flounder.
55	Pleuronectiformes	Bothidae	<i>Perissias taeniopterus</i> (Gilbert, 1890)	P	Ma	Striped-fin flounder.
55	Pleuronectiformes	Cynoglossidae	<i>Syphurus arawak</i> Robins & Randall, 1965	A	Ma	Caribbean tonguefish.
55	Pleuronectiformes	Cynoglossidae	<i>Syphurus elongatus</i> (Günther, 1868)	P	Ma	Elongate tonguefish.
55	Pleuronectiformes	Cynoglossidae	<i>Syphurus leei</i> Jordan & Bollman, 1890	P	Ma	Lee's tonguefish.
55	Pleuronectiformes	Cynoglossidae	<i>Syphurus plagiusa</i> (Linnaeus, 1766)	A	Ma	Very abundant in shallow coastal waters and estuaries. Blackcheek tonguefish.
55	Pleuronectiformes	Cynoglossidae	<i>Syphurus sp.</i>	P, A	Ma	
55	Pleuronectiformes	Paralichthyidae	<i>Ancylorsetta dendritica</i> Gilbert, 1890	P	Ma	Three-spot flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Citharichthys gibberti</i> Jenkins & Evermann, 1889	P	Ma	commonly found in estuaries; sometimes enters freshwater. Bigmouth sanddab.
55	Pleuronectiformes	Paralichthyidae	<i>Citharichthys gordae</i> Beebe & Tee-Van, 1938	P	Ma	Mimic sandab.
55	Pleuronectiformes	Paralichthyidae	<i>Citharichthys platophys</i> Gilbert, 1891	P	Ma	Small sandab.
						Inhabit mainly coastal waters, but abundant in waters very near the sea to a few meters elevation with wholly freshwater ichthyofauna. Freshwater, brackish and marine habitats. Bay whiff.
55	Pleuronectiformes	Paralichthyidae	<i>Citharichthys spilopterus</i> Günther, 1862	A	Ma	
55, 51	Pleuronectiformes	Paralichthyidae	<i>Citharichthys evermanni</i> Meek & Hildebrand	A	Ma	
55	Pleuronectiformes	Paralichthyidae	<i>Cyclopsetta panamensis</i> (Steindachner, 1876)	P	Ma	God's flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Cyclopsetta querna</i> (Jordan & Bollman, 1890)	P	Ma	Toothed flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Etropus crossopterus</i> Jordan & Gilbert, 1882	P	Ma	Fringed flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Etropus ectenes</i> Jordan, 1889	P	Ma	Sole flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Etropus sp.</i>	P	Ma	
55	Pleuronectiformes	Paralichthyidae	<i>Hippoglossina tetrophthalmus</i> (Gilbert, 1890)	P	Ma	Fourspot flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Syacium gunteri</i> Ginsburg, 1933	A	Ma	Shoal flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Syacium latifrons</i> (Jordan & Gilbert, 1882)	P	Ma	Beach flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Syacium micrurum</i> Ranzani, 1842	A	Ma	Channel flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Syacium ovale</i> (Günther, 1864)	P	Ma	Oval flounder.
55	Pleuronectiformes	Paralichthyidae	<i>Syacium papillosum</i> (Linnaeus, 1758)	A	Ma	Dusky flounder.
55	Rajiformes	Dasyatidae	<i>Dasyatis brevis</i> Springer	P	Ma	Collected in depths <50 m. Whiptail stingray
55	Rajiformes	Dasyatidae	<i>Dasyatis longa</i> (Garman, 1880)	P	Ma	Collected in depths <50 m. Longtail stingray
55	Rajiformes	Myliobatidae	<i>Rhinoptera steindachneri</i> Evermann & Jenkins	P	BMa	Collected in depths <50 m. Pacific cownose ray
55	Rajiformes	Rhinobatidae	<i>Rhinobatos lentiginosus</i> Garman, 1880	A	Ma	Inhabits sandy and weedy bottoms. Atlantic guitarfish.
55	Rajiformes	Rhinobatidae	<i>Rhinobatos leucorhynchus</i> (Gunther)	P	Ma	Collected in depths <50 m
55	Rajiformes	Torpedinidae	<i>Diplobatis ommatia</i> (Jordan & Gilbert)	P	Ma	Collected in depths <50 m
55	Rajiformes	Urolophidae	<i>Urotrygon munda</i> Gill, 1863	P	BMa	Collected in depths <50 m. Munda round ray. <i>Urolophus munda</i> Gill en (55).
55	Rajiformes	Urolophidae	<i>Urobatis jamaicensis</i> (Cuvier, 1816)	A	Ma	Yellow stingray.
55	Scorpaeniformes	Dactylopteridae	<i>Dactylopterus volitans</i> (Linnaeus, 1758)	A	Ma	Flying gurnard.
55	Scorpaeniformes	Scorpaenidae	<i>Pontinus furcifinus</i> Garman, 1899	P	Ma	Red scorpionfish.
55	Scorpaeniformes	Scorpaenidae	<i>Scorpaena grandicornis</i> Cuvier, 1829	A	Ma	Plumed scorpionfish.
55	Scorpaeniformes	Scorpaenidae	<i>Scorpaena russula</i> Jordan & Bollman, 1890	P	Ma	Reddish scorpionfish.
55	Scorpaeniformes	Scorpaenidae	<i>Scorpaenodes caribbaeus</i> Meek & Hildebrand, 1928	A	Ma	Reef scorpionfish.
55	Scorpaeniformes	Scorpaenidae	<i>Scorpaenodes tredecimspinosa</i> (Metzelaar, 1919)	A	Ma	Deepreef scorpionfish.
55	Scorpaeniformes	Triglidae	<i>Bellator loxias</i> (Jordan, 1897)	P	Ma	Barred searobin.
55	Scorpaeniformes	Triglidae	<i>Bellator xenismus</i> (Jordan & Bollman, 1890)	P	Ma	
55	Scorpaeniformes	Triglidae	<i>Prionotus punctatus</i> (Bloch, 1793)	A	Ma	Bluewing searobin.
55	Scorpaeniformes	Triglidae	<i>Prionotus sp.</i>	A	Ma	
55	Scorpaeniformes	Triglidae	<i>Prionotus quiescens</i> Lockington, 1881	P	Ma	
55	Siluriformes	Ariidae	<i>Bagre panamensis</i> (Gill, 1863)	P	Ma	Found inshore, usually on muddy bottoms and enters in the estuaries. Chihui sea catfish.
51	Siluriformes	Ariidae	<i>Cathorops tuyra</i> (Meek & Hildebrand, 1923)	G, M	Ma	Besudo sea catfish. Found in marine, brackish and fresh waters.
55	Siluriformes	Ariidae	<i>Hexanematichthys dowii</i> (Gill, 1863)	P	Ma	Found in estuaries and rivers. Brown sea catfish.

Table 2-4 B. List of Marine Fishes Reported to Gatún, Miraflores Lakes Miraflores and the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
UP-ACP04	Siluriformes	Ariidae	<i>Hexanemichthys platypogon</i> (Günther, 1864)	M	Br, Ma	Peripheral specie with economic value.
55	Siluriformes	Ariidae	<i>Hexanemichthys seemanni</i> (Günther, 1864)	P	Ma	Common in coastal marine and brackish waters and Inhabits medium and large rivers to an elevation of at least 25 m. Tete sea catfish. Peripheral specie.
55	Squaliformes	Carcharhinidae	<i>Carcharhinus porosus</i> (Ranzani)	P	Ma	Collected in depths <50 m
55	Squaliformes	Carcharhinidae	<i>Rhizoprionodon longurio</i> (Jordan & Gilbert)	P	Ma	Collected in depths <50 m
55	Squaliformes	Sphyrnidae	<i>Sphyrna media</i> Springer	P	Ma	Collected in depths <50 m
55	Squaliformes	Sphyrnidae	<i>Sphyrna tiburo vespertina</i> Springer	P	Ma	Collected in depths <50 m
55	Stomiiformes	Gonostomatidae	<i>Bonapartis pedalota</i> Goode & Bean, 1896	A	Ma	
55	Syngnathiformes	Fistulariidae	<i>Fistularia corneta</i> Gilbert & Starks, 1904	P	Ma	Pacific cornetfish.
55	Syngnathiformes	Fistulariidae	<i>Fistularia tabacaria</i> Linnaeus, 1758	A	Ma	Cornet fish.
55	Syngnathiformes	Syngnathidae	<i>Hippocampus reidi</i> Ginsburg, 1933	A	Ma	Vulnerable, IUCN Red List. Longsnout seahorse.
94	Syngnathiformes	Syngnathidae	<i>Microphis brachyurus lineatus</i> (Kaup, 1856)	A, M	Ma	Euryhaline. Peripheral specie.
55	Syngnathiformes	Syngnathidae	<i>Pseudophallus mindii</i> (Meek & Hildebrand, 1923)	A	Ma	Benthopelagic; freshwater; brackish. Most specimens were collected from freshwater habitats.
55	Syngnathiformes	Syngnathidae	<i>Syngnathus rousseau</i> Kaup	A	Ma	
55	Tetraodontiformes	Balistidae	<i>Balistes capriscus</i> Gmelin, 1789	A	Ma	Grey triggerfish.
55	Tetraodontiformes	Balistidae	<i>Balistes sp.</i>	A	Ma	
55	Tetraodontiformes	Balistidae	<i>Canthidermis sufflamen</i> (Mitchill, 1815)	A	Ma	Ocean triggerfish.
55	Tetraodontiformes	Balistidae	<i>Pseudobalistes naufragium</i> (Jordan & Starks, 1895)	P	Ma	Stone triggerfish.
55	Tetraodontiformes	Diodontidae	<i>Diodon holocanthus</i> Linnaeus, 1758	P, A	Ma	Long-spine porcupinefish.
55	Tetraodontiformes	Diodontidae	<i>Diodon hystrix</i> Linnaeus, 1758	P	Ma	Spot-fin porcupinefish.
55	Tetraodontiformes	Monacanthidae	<i>Aluterus schoepfii</i> (Walbaum, 1792)	A	Ma	Orange filefish.
55	Tetraodontiformes	Monacanthidae	<i>Aluterus scriptus</i> (Osbeck, 1765)	A	Ma	Scrawled filefish.
55	Tetraodontiformes	Monacanthidae	<i>Monacanthus ciliatus</i> (Mitchill, 1818)	A	Ma	Fringed filefish.
55	Tetraodontiformes	Monacanthidae	<i>Monacanthus tuckeri</i> Bean, 1906	A	Ma	Slender filefish.
55	Tetraodontiformes	Ostraciidae	<i>Acanthostracion quadricornis</i> (Linnaeus, 1758)	A	Ma	Scrawled cowfish.
55	Tetraodontiformes	Tetradontidae	<i>Arothron hispidus</i> (Linnaeus, 1758)	P	Ma	White-spotted puffer.
55	Tetraodontiformes	Tetradontidae	<i>Canthigaster rostrata</i> (Bloch, 1786)	A	Ma	Caribbean sharpnose-puffer.
55	Tetraodontiformes	Tetradontidae	<i>Guentheridium formosa</i> (Günther, 1870)	P	Ma	Carnivorous. Spotted puffer.
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides spengleri</i> Bloch	A	Ma	
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides annulatus</i> (Jenyns, 1842)	P	Ma	Bullseye puffer.
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides greeleyi</i> (Gilbert, 1900)	A	Ma	Green puffer.
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides lobatus</i> (Steindachner, 1870)	P	Ma	Longnose puffer.
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides sp.</i>	P	Ma	
55	Tetraodontiformes	Tetradontidae	<i>Sphoeroides testudineus</i> (Linnaeus, 1758)	A	Ma	Checkered puffer.
55	Torpediniformes	Narcinidae	<i>Narcine brasiliensis</i> (Olfers, 1831)	A	BMa	Brazilian electric ray.
Total of MARINE SPECIES				315		

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= Gatun Lake

M= Miraflores Lake; PDM= Pedro Miguel Locks; GL: Gatun Locks; ML: Miraflores Locks

Fr=Freshwater; Ma=Marine; Br= Brackish; B=Benthos

BCI= Barro Colorado Island

UP-ACP04: Biological Inventory raised by the Universidad de Panamá to the Panama Canal in 2004.

Tabla 2-4 C. List of Freshwater Fishes Reported in Gatún And Miraflores Lakes.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
60	Perciformes	Eleotridae	<i>Dormitator maculatus</i> (Bloch, 1792)	A, M	Fr, Ma	Demersal; amphidromous (Ref. 51243); freshwater; brackish; marine environments. Fat sleeper.
86, 88	Perciformes	Centrarchidae	<i>Micropterus salmoides</i> (Lacepède, 1802)	G	Fr	Benthopelagic; freshwater. introducec in the Gatun lake in 1924. Largemouth bass
88	Perciformes	Centrarchidae	<i>Pomoxis annularis</i> Rafinesque, 1818	G	Fr	Introduced in 1924. White crappie NO EXISTE
51	Characiformes	Characidae	<i>Colossoma macropomum</i> (Cuvier, 1818)	G	Fr	Exotic specie.
85	Characiformes	Characidae	<i>Compurra gorgonae</i> (Evermann & Goldsborough, 1909)	G	Fr	Benthopelagic; freshwater. Primary specie
88	Characiformes	Characidae	<i>Creagrus affinis</i> Steindachner, 1880	G	Fr	Reported to BCI. Benthopelagic; freshwater. Primary specie
51	Characiformes	Characidae	<i>Cyphocharax magdalena</i> (Steindachner, 1878)	G	Fr	Primary specie
85, 60	Characiformes	Characidae	<i>Hypessobrycon panamensis</i> Durbin, 1908	G	Fr	Benthopelagic; freshwater. Primary specie
						Atlantic slope drainages of Panama from Gatun Lake including the basin of the Chagres River. Benthopelagic and freshwater environments. Guatemalan headstander. Primary specie
85, 60	Characiformes	Characidae	<i>Roeboides guatemalensis</i> (Günther, 1864)	G	Fr	Oscar. Exotic. Primary specie
86, 51	Perciformes	Cichlidae	<i>Astronotus ocellatus</i> (Agassiz, 1831)	G	Fr	Benthopelagic; freshwater; brackish environments. Peacock cichlid. Secondary specie. Abundance relative of 29.1% in (51) Primary specie
85, 51	Perciformes	Cichlidae	<i>Cichla ocellaris</i> Bloch & Schneider, 1801	G	Fr	Exotic specie. Flag cichlid. Primary specie
UP-ACP04	Perciformes	Cichlidae	<i>Mesonauta festivus</i> (Heckel, 1840)	G	Fr	Nile tilapia. Introduced specie. Secondary specie
86, 51	Perciformes	Cichlidae	<i>Oreochromis niloticus niloticus</i> (Linnaeus, 1758)	G	Fr	Secondary specie
UP-ACP04	Perciformes	Cichlidae	<i>Vieja tuyrensis</i> (Meek & Hildebrand, 1913)	G	Fr	Common carp.
88	Perciformes	Eleotridae	<i>Leptophilypus mindii</i> (Meek & Hildebrand, 1916)	G	Fr	Demersal; brackish.peripheral
60, 51	Siluriformes	Heptapteridae	<i>Rhamdia quelen</i> (Quoy & Gaimard, 1824)	G	Fr	Primary specie
88	Gymnotiformes	Hypopomidae	<i>Brachyhypopomus brevirostris</i> (Steindachner, 1868)	G	Fr	Benthopelagic; freshwater, reported to BCI. Bluntnose knifefish. Primary specie.
51	Siluriformes	Loricariidae	<i>Hypostomus panamensis</i> (Eigenmann, 1922)	G	Fr	
88	Cyprinodontiformes	Poeciliidae	<i>Brachyrhaphis cascajalensis</i> (Meek & Hildebrand, 1913)	G	Fr	pelagic; non-migratory; freshwater; brackish. Secondary specie.
UP-ACP04	Cyprinodontiformes	Poeciliidae	<i>Brachyrhaphis parismina</i> (Meek, 1912)	G	Fr	
85, 51, UP-ACP04	Cyprinodontiformes	Poeciliidae	<i>Gambusia nicaraguensis</i> Günther, 1866	G	Fr	Collected only on three occasions in the mouth of slow-moving streams, in brackish or fresh waters within a few meters of the sea. benthopelagic; freshwater; brackish, salty water. Nicaraguan mosquitofish. Secondary specie
85	Cyprinodontiformes	Poeciliidae	<i>Poecilia mexicana</i> Steindachner, 1863	G	Fr	Benthopelagic; non-migratory; freshwater; brackish.
UP-ACP04	Cyprinodontiformes	Poeciliidae	<i>Poeciliopsis turrubarensis</i> (Meek, 1912)	G	Fr	Lives in estuaries along the coast, in brooks, creeks and swift rivers.
60	Cyprinodontiformes	Rivulidae	<i>Rivulus brunneus</i> Meek & Hildebrand, 1913	G	Fr	Reported to Barro Colorado island. Secondary specie
	Cyprinodontiformes	Rivulidae	<i>Rivulus elegans</i> Steindachner, 1880	G	Fr	Benthopelagic; non-migratory; freshwater; pH range: 7.0.
88	Synbranchiformes	Synbranchidae	<i>Synbranchus marmoratus</i> Bloch, 1795	G	Fr	Demersal; potamodromous; freshwater; brackish environments. Marbled swamp eel. Secondary specie
UP-ACP04	Perciformes	Cichlidae	<i>Parachromis dovii</i> (Günther, 1864)	G	Fr, Ma	Inhabits lakes but also thrives in various lower and middle river valleys. Guapote. Exotic specie
88	Perciformes	Eleotridae	<i>Guavina guavina</i> (Valenciennes, 1837)	G	Fr, Ma	Demersal; oceano-estuarine; freshwater; brackish; marine. Guavina
88	Perciformes	Gobiidae	<i>Awaous tajasicus</i> (Lichtenstein, 1822)	G	Fr, Ma	Demersal; catadromous; freshwater; brackish; marine. Sand fish
88	Perciformes	Gobiidae	<i>Sicydium salvini</i> Ogilvie-Grant, 1884	G	Fr, Ma	Adults inhabit fresh water.
88	Syngnathiformes	Syngnathidae	<i>Microphis brachyurus lineatus</i> (Kaup, 1856)	G	Ma	pelagic; oceano-estuarine; marine environments. Found among floating sargassum. Collected in Barro Colorado Island.
UP-ACP04	Perciformes	Eleotridae	<i>Awaous banana</i> (Valenciennes, 1837)	G	Br, Fr	Feeds mainly on filamentous algae. River goby.
UP-ACP04	Characiformes	Characidae	<i>Astyanax orthodus</i> Eigenmann, 1907	G, M	Fr	Primary specie.
UP-ACP04	Characiformes	Characidae	<i>Brycon behreae</i> Hildebrand, 1938	G, M	Fr	Primary specie.
86, 51	Characiformes	Characidae	<i>Brycon chagrensis</i> (Kner, 1863)	G, M	Fr	Benthopelagic; freshwater. Primary specie. 12 % of Abundance relative in (51)
60, 88	Characiformes	Characidae	<i>Brycon petrosus</i> Meek & Hildebrand, 1913	G, M	Fr	reported in 1938 to these sites. Primary specie
60, 51	Characiformes	Characidae	<i>Roeboides occidentalis</i> Meek & Hildebrand, 1916	G, M	Fr	Primary and Exotic specie.
85, 60, 88, UP-ACP04	Perciformes	Cichlidae	<i>Aequidens coeruleopunctatus</i> (Kner & Steindachner, 1863)	G, M	Fr	Benthopelagic, freshwater environments. Secondary specie
UP-ACP04	Perciformes	Cichlidae	<i>Archocentrus nigrofasciatus</i> (Günther, 1867)	G, M	Fr	Convict cichlid. Is a Primary specie.
85, 88, 51	Perciformes	Cichlidae	<i>Archocentrus panamensis</i> (Meek & Hildebrand, 1913)	G, M	Fr	Benthopelagic; freshwater; pH range: 7.0 - 8.0. Secondary specie
60, 88	Perciformes	Cichlidae	<i>Geophagus crassilabris</i> Steindachner, 1876	G, M	Fr	not seem common in both lakes. Panamanian eartheater. Secondary specie

Tabla 2-4 C. List of Freshwater Fishes Reported in Gatún And Miraflores Lakes.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
85, 88, 51, UP-ACP04	Perciformes	Cichlidae	<i>Vieja maculicauda</i> (Regan, 1905)	G, M	Fr	Able to tolerate brackish and marine conditions. Benthopelagic; potamodromous; freshwater; brackish environments. Blackbelt cichlid. Secondary specie
60	Perciformes	Eleotridae	<i>Gobiomorus maculatus</i> (Günther, 1859)	G, M	Fr	
60	Perciformes	Eleotridae	<i>Leptophlypnus fluviatilis</i> Meek & Hildebrand, 1916	G, M	Fr	Demersal; brackish.
85, 86, 60, 88	Characiformes	Erythrinidae	<i>Hoplias microlepis</i> (Günther, 1864)	G, M	Fr	Collected in creeks and swamps in areas of little or no current. Primary specie. 28% of Abundance Relative in (51)
60	Characiformes	Lebiasinidae	<i>Piabucina panamensis</i> Gill, 1877	G, M	Fr	was reported in an affluent of Miraflores Lake.
60, 88	Cyprinodontiformes	Poeciliidae	<i>Poecilia sphenops</i> Valenciennes, 1846	G, M	Fr	benthopelagic; non-migratory; freshwater; brackish. Molly . Secondary specie
60	Cyprinodontiformes	Poeciliidae	<i>Poeciliopsis elongata</i> (Günther, 1866)	G, M	Fr	Collected in the manholes of Miraflores Lock. Elongate toothcarp. Secondary specie.
85, 33, 51	Characiformes	Characidae	<i>Astyanax ruberrimus</i> Eigenmann, 1913	G, M	Fr	Benthopelagic; freshwater. Primary specie
62, 60	Perciformes	Eleotridae	<i>Eleotris picta</i> Kner & Steindachner, 1863	G, M	Fr, Ma	Demersal; catadromous, freshwater; brackish; marine environments. Appears to prefer estuarine freshwater tributaries, occurring in waters with a salinity range of 0 to 19 ppt. Spinycheek sleeper
85, 60, 88	Perciformes	Eleotridae	<i>Gobiomorus dormitor</i> Lacepède, 1800	G, M	Fr, Ma	Freshwater; brackish; marine environments. Bigmouth sleeper. Peripheral specie
60, 88, 33	Characiformes	Characidae	<i>Bryconamericus emperador</i> (Eigenmann & Ogle, 1907)	G, M	Fr	Benthopelagic; freshwater. Primary specie
60, 88	Perciformes	Mugilidae	<i>Agonostomus monticola</i> (Bancroft, 1834)	G, M, A, P	Br, Fr, Ma	Was reported in an affluent of Miraflores Lake. Dajao
85, 88, UP- ACP04	Atheriniformes	Atherinopsidae	<i>Atherinella chagresi</i> (Meek and Hildebrand in Meek, 1914)	GL, ML, PDML	Fr, Ma	Gatun locks in the upper, middle chambers; Miraflores locks in the lower chamber and Pedro Miguel locks. Inhabits rivers of low to high current velocity, between 8 and 60 m elevation. benthopelagic; freshwater; brackish; marine environments. Is a Peripheral specie.
85, 88	Characiformes	Characidae	<i>Pseudocheirodon arnoldi</i> (Boulenger, 1909)	P, A, G	Fr	Atlantic and Pacific versant rivers of Panama and BCI. Primary specie
UP-ACP04	Characiformes	Characidae	<i>Roebooides ilseae</i> Bussing, 1986	M	Fr	Primary specie.
60	Perciformes	Eleotridae	<i>Euleptoeleotris clarki</i>	ML	Fr	Collected in the locks.
60	Perciformes	Eleotridae	<i>Dormitator latifrons</i> (Richardson, 1844)	M	Fr, Ma	Typically in freshwater but moves freely into the sea. Peripheral specie. Pacific fat sleeper.
62	Perciformes	Eleotridae	<i>Eleotris pisonis</i> (Gmelin, 1789)	M	Fr, Ma	Demersal; freshwater; brackish waters. More abundant near the coast and only large individuals are found upstream. Spotted sleeper
33	Siluriformes	Heptapteridae	<i>Pimelodella chagresi</i> (Steindachner, 1877)	P, A	Fr	Primary specie
UP-ACP04	Cyprinodontiformes	Poeciliidae	<i>Poecilia gilli</i> (Kner, 1863)	P, A, G	Fr	Inhabit swamps, brooks and in shallow waters of large rivers.

Total of Fresh Waters Fishes

63

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= Gatun Lake

M= Miraflores Lake; PDM= Pedro Miguel Locks; GL: Gatun Locks; ML: Miraflores Locks.

Fr=Freshwater; Ma=Marine; Br= Brackish

BCI= Barro Colorado Island

UP/ACP04: Biological Inventory raised by the Universidad de Panamá to the Panama Canal in 2004.

Table 2-4 D. List of Corals Reported to the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
ANTHOZOANS						
55	Gorgonacea	Anthothelidae	<i>Erythropodium caribaeorum</i> (Duchass. and Michelotti, 1860)	A	Ma	Octocoral
55	Gorgonacea	Briareidae	<i>Briareum asbestinum</i> (Pallas, 1766)	A	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Gorgia flabellum</i> Linnaeus, 1758	A	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Gorgia ventalina</i> Linnaeus, 1758	A	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Lophogorgia alba</i> Duchassing & Michelotti	P	BMa	Cited in these inventory
55	Gorgonacea	Gorgoniidae	<i>Lophogorgia sp1.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Lophogorgia sp2.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Lophogorgia sp3.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Lophogorgia sp4.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Pacifigorgia sp1.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Pacifigorgia sp2.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Pacifigorgia sp3.</i>	P	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Pseudopterogorgia acerosa</i> (Pallas, 1766)	A	Ma	Octocoral
55	Gorgonacea	Gorgoniidae	<i>Pterogorgia anceps</i> (Pallas, 1766)	A	Ma	Octocoral
55	Pennatulacea	Pennatulidae	<i>Ptilosarcus sinosus</i> gray	P	Ma	
21	Pennatulacea	Renillidae	<i>Renilla amethystina</i>	P	Ma	
55	Gorgonacea	Plexauridae	<i>Eunicea succinea</i> (Pallas, 1766)	A	Ma	Octocoral
55	Gorgonacea	Plexauridae	<i>Eunicea sp.</i>	A	Ma	Octocoral
55	Gorgonacea	Plexauridae	<i>Muricea sp1.</i>	P	Ma	Octocoral
55	Gorgonacea	Plexauridae	<i>Muricea sp2.</i>	P	Ma	Octocoral
55	Gorgonacea	Plexauridae	<i>Muriceopsis flava</i> (Lamarck, 1815)	A	Ma	Octocoral
55	Gorgonacea	Plexauridae	<i>Pseudoplexaura flagellosa</i> (Houttuyn, 1772)	A	Ma	Octocoral
55	Scleractinia	Acroporidae	<i>Acropora cervicornis</i> Lamarck, 1816	A	Ma	Hermatipic coral
55	Scleractinia	Acroporidae	<i>Acropora palmata</i> Lamarck, 1816	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia agaricites</i> (Linnaeus, 1758)	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia agaricites f. carinata</i> Edwards, 1973	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia agaricites f. danai</i> Milne Edwards & Haime	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia agaricites f. humilis</i> (Verril)	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia agaricites f. purpurea</i> (Lesueur, 1821)	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia fargilis</i> Dana, 1848	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia lamarcki</i> Milne Edwards & Haime, 1851	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia sp.</i>	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Agaricia tenuifolia</i> Dana, 1848	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Leptoseris cucullata</i> (Ellis & Solander, 1786)	A	Ma	Hermatipic coral
55	Scleractinia	Agariciidae	<i>Pavona clavus</i> (Dana, 1846)	P	Ma	Hermatipic coral. Madrépores, stony corals.
55	Scleractinia	Agariciidae	<i>Pavona gigantea</i> Verrill, 1869	P	Ma	Hermatipic coral. Madrépores, stony corals.
55	Scleractinia	Agariciidae	<i>Pavona sp.1</i>	P	Ma	Hermatipic coral. Madrépores, stony corals.

Table 2-4 D. List of Corals Reported to the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Scleractinia	Agariciidae	<i>Pavona sp.2</i>	P	Ma	Hermatipic coral. Madrépores, stony corals.
55	Scleractinia	Agariciidae	<i>Pavona venosa</i> (Ehrenberg, 1834)	P	Ma	Hermatipic coral. Madrépores, stony corals.
55	Scleractinia	Astrocoeniidae	<i>Stephanocoenia intersepta</i> Lamarck	A	Ma	Coral hermatípico
55	Scleractinia	Caryophylliidae	<i>Colangia immersa</i> De Pourtalès, 1871	A	Ma	Ahermatipic coral.
55	Scleractinia	Caryophylliidae	<i>Colangia sp.</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Caryophylliidae	<i>Paracyathus humilis</i> Verrill, 1870	P	Ma	Ahermatipic coral.
55	Scleractinia	Caryophylliidae	<i>Phyllangia americana americana</i> Milne-Edwards and Haime, 1849	A	Ma	Ahermatipic coral.
55	Scleractinia	Caryophylliidae	<i>Phyllangia sp.</i>	P	Ma	Ahermatipic coral.
55	Scleractinia	Dendrophylliidae	<i>Balanophyllia sp.</i>	P, A	Ma	Ahermatipic coral.
55	Scleractinia	Dendrophylliidae	<i>Tubastrea coccinea</i> Lesson	P	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Cladocora arbuscula</i> Lesueur, 1758	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Colpophyllia breviserialis</i> M. Edwards & Haime, 1849	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Colpophyllia natans</i> (Houttuyn, 1772)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Diploria clivosa</i> (Ellis & Solander, 1786)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Diploria labyrinthiformis</i> (Linnaeus, 1758)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Diploria strigosa</i> (Dana, 1846)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Favia fragum</i> (Esper, 1795)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Manicina aereaolata</i> Linnaeus, 1758	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Montastraea annularis</i> (Ellis and Solander, 1786)	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Montastraea cavernosa</i> Linnaeus, 1767	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Montastraea sp.</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Solenastrea bournoni</i> M. Edwards & Haime, 1850	A	Ma	Ahermatipic coral.
55	Scleractinia	Faviidae	<i>Solenastrea hyades</i> (Dana, 1846)	A	Ma	Ahermatipic coral.
55	Scleractinia	Gardineriidae	<i>Gardineria sp1.</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Gardineriidae	<i>Gardineria sp2.</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Meandrinidae	<i>Dichocoenia stokesi</i> M. Edwards & Haime, 1848	A	Ma	Ahermatipic coral.
55	Scleractinia	Meandrinidae	<i>Meandrina meandrites</i> (Linnaeus, 1758)	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Isophyllum rigida</i> Dana, 1848	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Isophyllum sinuosa</i> (Ellis & Solander, 1786)	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Mycetophyllia daniana</i> M. Edwards & Haime, 1849	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Mycetophyllia ferox</i> Wells, 1973	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Mycetophyllia lamarckiana</i> (M. Edwards & Haime, 1848)	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Scolymia cubensis</i> M. Edwards & Haime, 1849	A	Ma	Ahermatipic coral.
55	Scleractinia	Mussidae	<i>Scolymia lacera</i> (Pallas, 1766)	A	Ma	Ahermatipic coral.
55	Scleractinia	Oculinidae	<i>Oculina diffusa</i> Lamarck, 1816	A	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Madracis asperula</i> (M. Edwards & Haime, 1848)	A	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Madracis decactis</i> Lyman	A	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Madracis mirabilis sensu</i> Wells, 1973	A	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Madracis senaria</i> Wells, 1973	A	Ma	Ahermatipic coral.
42, 55	Scleractinia	Pocilloporidae	<i>Pocillopora damicornis</i> (Linnaeus, 1758)	P	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Pocillopora elegans</i> Dana, 1846	P	Ma	Ahermatipic coral.
55	Scleractinia	Pocilloporidae	<i>Pocillopora meandrina</i> Dana, 1846	P	Ma	Ahermatipic coral.

Table 2-4 D. List of Corals Reported to the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
55	Scleractinia	Poritidae	<i>Porites astreoides</i> Lamarck, 1816	A	Ma	Ahermatipic coral. mustard hill coral, yellow porites
55	Scleractinia	Poritidae	<i>Porites colonensis</i> Zlatarski, 1990	A	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites divaricata</i> Le Sueur, 1821	A	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites furcata</i> Lamarck, 1816	A	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites lobata</i> Dana, 1846	P	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites panamensis</i> Verrill, 1866	P	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites porites</i> (Pallas, 1766)	A	Ma	Ahermatipic coral.
55	Scleractinia	Poritidae	<i>Porites sp.</i>	P	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Psammocora stellata</i> Verrill, 1866	P	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Psammocora superficialis</i> Gardiner, 1898	P	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Siderastrea radians</i> (Pallas, 1766)	A	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Siderastrea siderea</i> (Ellis & Solander, 1786)	A	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Siderastrea sp.1</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Siderastrea sp.2</i>	A	Ma	Ahermatipic coral.
55	Scleractinia	Siderastreidae	<i>Siderastrea sp.</i>	P	Ma	Ahermatipic coral.
55	Scleractinia	Rhizangiidae	<i>Astrangia brownii</i> Palmer	P	Ma	Ahermatipic coral.
55	Scleractinia	Rhizangiidae	<i>Astrangia solitaria</i> (Lesueur, 1817)	A	Ma	Ahermatipic coral.
55	Scleractinia	Rhizangiidae	<i>Astrangia sp.</i>	P	Ma	Ahermatipic coral.
55	Scleractinia	Rhizangiidae	<i>Oulangia bradleyi</i> Verrill	P	Ma	Ahermatipic coral.
HYDROZOANS						
55	Capitata	Milleporidae	<i>Millepora alcicornis</i> Linnaeus, 1758	A	Ma	fire coral (coral de fuego). Hermatipic Coral
55	Capitata	Milleporidae	<i>Millepora complanata</i> Lamarck, 1816	A	Ma	bladed fire coral. Hermatipic Coral
55	Capitata	Milleporidae	<i>Millepora squarrosa</i> Lamarck, 1816	A	Ma	Hermatipic Coral
55	Filiifera	Styelidae	<i>Styela roseus</i> (Pallas, 1766)	A	Ma	Ahermatipic Coral
55	Canalipalpata	Serpulidae	<i>Hydroide No.2</i>	P	BMa	
55	Testudines	Chelidae	<i>Hydromedusa No1.</i>	P	BMa	
55	Testudines	Chelidae	<i>Hydromedusa No2.</i>	A	BMa	
55	Canalipalpata	Serpulidae	<i>Hydroide No.1</i>	A	BMa	

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ; G= Gatun Lake

M= Miraflores Lake; PDM= Pedro Miguel Locks

Fr=Freshwater; Ma=Marine; Br= Brackish; B= Benthos

UP/ACP04: Biological Inventory raised by the Universidad de Panamá to the Panama Canal in 2004.

Table 2-4 E. List of Insects Reported to the Lakes Gatún and Miraflores and to the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
24	Coleoptera	Orecochilinae	<i>Gyretes acutangulus</i> Sharp	G	Fr	
24	Coleoptera	Orecochilinae	<i>Gyretes centralis</i> Rgimbart	G	Fr	
24	Coleoptera	Dysticidae	<i>Laccophilus gentilis</i> Le Conte	G	Fr	
24	Coleoptera	Dysticidae	<i>Laccophilus zapotecus</i> Zimmerman	G	Fr	
24	Coleoptera	Dysticidae	<i>Thermonetus margineguttata</i> Aubé	G	Fr	
24	Coleoptera	Hydrophilidae	<i>Chaetarthria glabra</i> Sharp	G	Fr	
24	Coleoptera	Hydrophilidae	<i>Drophilus ater</i> Olivier	G	Fr	
46	Diptera	Ceratopogonidae	<i>Culicoides furens</i> Poey	P, A	Fr	Freshwaters Marshes
46	Diptera	Ceratopogonidae	<i>Culicoides guyanensis</i>	P, A	Fr	Freshwaters Marshes
24	Diptera	Haliplidae	<i>Haliplus panamanus</i>	G	Fr	
24	Diptera	Chironomidae	<i>Coelotanypus neotropicus</i> (Kieff.)	G	Fr	
24	Diptera	Chironomidae	<i>Coelotanypus humeralis</i> (Loew)	G	Fr	
24	Diptera	Chironomidae	<i>Coelotanypus scapularis</i> (Loew)	G	Fr	
24	Diptera	Chironomidae	<i>Coelotanypus naellis</i> Roback	G	Fr	
24	Diptera	Chironomidae	<i>Corynoneura spreta</i> Roback	G	Fr	
24	Diptera	Chironomidae	<i>Cricotopus tauris</i> Roback	G	Fr	
24	Diptera	Chironomidae	<i>Cricotopus oris</i> Roback	G	Fr	
24	Diptera	Chironomidae	<i>Cantonya cara</i>	G	Fr	
24	Diptera	Chironomidae	<i>Polypedilum pterospilus</i> Townes	G	Fr	
24	Diptera	Chironomidae	<i>Chironomus aversa</i>	G	Fr	
24	Diptera	Chironomidae	<i>Goeldichironomus holoprasinus</i> (Goeldi, 1905)	G	Fr	Chironomus fulvipilus in Hogue(24)
24	Diptera	Chaoboridae	<i>Sayomyia brasiliensis</i> (Theo.)	G	Fr	
24	Diptera	Chaoboridae	<i>Sayomyia souzae</i> (Lane)	G	Fr	
24	Diptera	Corethrellidae	<i>Corethrella ananacola</i> Dyar	G	Fr	
24	Diptera	Corethrellidae	<i>Corethrella blanda</i> Dyar	G	Fr	
24	Diptera	Corethrellidae	<i>Corethrella dyari</i> Lane	G	Fr	
46	Diptera	Culicidae	<i>Aedeomyia (Aedeomyia) squamipennis</i> (Lynch Arribalzaga)	P, A	Fr	This species is partner to <i>Pistia stratiotes</i> and <i>Salvinia</i> sp. He can turn out to be affected by falls salinity between 0.5 and 5 %.
46	Diptera	Culicidae	<i>Anopheles albimanus</i> Wiedemann	G	Fr	It is associated with <i>Hydrilla verticillata</i> and is a vector of the malaria. It can reproduce in waters with salinity between 0.5 and 5 %, Boreham (46).
46	Diptera	Culicidae	<i>Anopheles triannulatus</i> (Neiva and Pinto, 1922)	G	Fr	Inn-keeper can of plasmodio human being. It can disappear in waters with salinity between 0.5 and 5 %, Boreham (46).
46	Diptera	Culicidae	<i>Anopheles pseudopunctipennis</i> Theobald, 1901	G	Fr	Considered as primary vector of malaria in Center and South America. It is found occasionally. Boreham (46)
46	Diptera	Culicidae	<i>Anopheles aquasalis</i> Curry	A	Br	It deposits his eggs in saline habitats with salinity of 3.5 %.
46	Diptera	Culicidae	<i>Aedes taeniorhynchus</i> (Wiedemann, 1821)	A	Br	Inn-keeper of the virus of San Luis's encephalitis. Swampy mangroves.
46	Diptera	Culicidae	<i>Culex (Melanoconion) panicossa</i> Dyar	P, A	Fr	<i>Culex aikenii</i> in Boreham (46). It has no tolerance great to the salinity.
46	Diptera	Culicidae	<i>Deinocerites atlanticus</i> Adames	P, A	Br	
46	Diptera	Culicidae	<i>Deinocerites dyari</i> Dyar & Knab	P, A	Br	
46	Diptera	Culicidae	<i>Deinocerites panamensis</i> Adames	P, A	Br	
46	Diptera	Culicidae	<i>Deinocerites pseudes</i> Dyar & Knab	P, A	Br	
46	Diptera	Culicidae	<i>Deinocerites spanius</i> Dyar & Knab	P, A	Br	
46	Diptera	Culicidae	<i>Mansonia dyari</i> Belkin, Heinemann and Page	G	Fr	It has no tolerance great to the salinity.
46	Diptera	Culicidae	<i>Mansonia titillans</i> (Walker, 1848)	G	Fr	Vector of the filariasis and of the equine Venezuelan encephalitis.. It has no tolerance great to the salinity.
46	Diptera	Culicidae	<i>Mansonia lebri</i> Boreham.	G	Fr	It has no tolerance great to the salinity.
46	Diptera	Culicidae	<i>Mansonia pseudotitillans</i> (Theobald)	G	Fr	It has no tolerance great to the salinity.
46	Diptera	Culicidae	<i>Coquillettidia nigricans</i>	P, A	Fr	The guaroa virus was reported in this insect.. It has no tolerance great to
46	Diptera	Culicidae	<i>Coquillettidia venezuelensis</i>	P, A	Fr	It has no tolerance great to the salinity.

Table 2-4 E. List of Insects Reported to the Lakes Gatún and Miraflores and to the Atlantic and Pacific Entrances of the Panama Canal.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	COMMENTS
46	Diptera	Culicidae	<i>Uranotaenia apicalis</i> Theobald	P, A	Fr	Associated to Pistia and Jussiaea natans.
46	Diptera	Culicidae	<i>Uranotaenia lowii</i> Theobald	G	Fr	Associated to Hydrilla verticillata and should be affected by salinity between 0.5 y 5%.
24	Hemiptera	Belastomatidae	<i>Belastoma micontulum</i> Stal	G	Fr	
24	Hemiptera	Belastomatidae	<i>Belastoma subspinum cupreomicans</i>	G	Fr	
24	Hemiptera	Belastomatidae	<i>Lethocerus colossicus</i> (STAL)	G	Fr	
24	Hemiptera	Gelastocoridae	<i>Gelastocoris major</i> Montandon	G	Fr	
24	Hemiptera	Gelastocoridae	<i>Nerthra raptoria</i> Fabricius	G	Fr	
24	Hemiptera	Gelastocoridae	<i>Nerthra rufis</i> Melin	G	Fr	
24	Hemiptera	Ochteridae	<i>Ochterus manni</i> Hungerford	G	Fr	
24	Hemiptera	Ochteridae	<i>Ochterus viridifrons</i> Champion	G	Fr	
24	Hemiptera	Naucoridae	<i>Ambrysus geayi</i> Montandon	G	Fr	
24	Hemiptera	Naucoridae	<i>Ambrysus horvathi</i> Montandon	G	Fr	
24	Hemiptera	Naucoridae	<i>Ambrysus oblongulus</i> Montandon	G	Fr	
24	Hemiptera	Naucoridae	<i>Pelocoris nitidus</i> Montandon	G	Fr	
24	Hemiptera	Nepidae	<i>Ranatra zeteki</i> Drake & De Carlo	G	Fr	Hogue (24) placed it to the order Heteroptera.
24	Hemiptera	Notonectidae	<i>Buenoa pallipes</i> Fabricius	G	Fr	Hogue (24) placed it to the order Heteroptera.
24	Hemiptera	Notonectidae	<i>Buenoa platycnemis</i> Fieber	G	Fr	Hogue (24) placed it to the order Heteroptera.
24	Hemiptera	Notonectidae	<i>Martarega hondurensis</i> Bare	G	Fr	Hogue (24) placed it to the order Heteroptera.
24	Hemiptera	Notonectidae	<i>Martarega williamsi</i> Truxal	G	Fr	Hogue (24) placed it to the order Heteroptera.
24	Hemiptera	Pleidae	<i>Paraplea puella</i> Barber	G	Fr	

A= Atlantic entrance of the Panama Canal; P=Pacific entrance of the Panama Canal ;

M= Miraflores Lake; G= Gatun Lake

Fr=Freshwater; Ma=Marine; Br= Brackish

**Table 2-9. List of Species of Flora that Should Lost by an Increase in of the Salinity
in the Lakes Gatun and Miraflores.**

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
CYANOPHYTAS						
68	Oscillatoriales	Oscillatoriaceae	<i>Oscillatoria cf. Tenuis Agardh</i>	PDML**	Fr	2
UP/ACP04	Oscillatoriales	Oscillatoriaceae	<i>Oscillatoria margaritifera (Kützing) Gomont</i>	G	Fr	2
UP/ACP04	Chroococcales	Chroococcaceae	<i>Chroococcus dispersus (Keissler) Lemmermann</i>	G	Fr	2
UP/ACP04	Chroococcales	Merismopediaceae	<i>Coelosphaerium dubium Grunow</i>	G	Fr	2
UP/ACP04	Chroococcales	Chroococcaceae	<i>Chroococcus limneticus Lemmermann</i>	G	Fr	2
28	Chroococcales	Chroococcaceae	<i>Chrococcus sp.</i>	G	Fr	1(28)
28	Chroococcales	Chroococcaceae	<i>Chrococchloris sp.</i>	G	Fr	1(28)
UP/ACP04	Chroococcales	Synechococcaceae	<i>Cyanothece aeruginosa (Nägeli) Komárek</i>	G	Fr	2
UP/ACP04	Oscillatoriales	Phormidiaceae	<i>Trichodesmium lacustre Klebahn</i>	G	Fr	2
UP/ACP04	Nostocales	Nostocaceae	<i>Nostoc plantonicum Poretsky & Tschernow</i>	G	Fr	2
UP/ACP04	Chroococcales	Entophysalidaceae	<i>Entophysalis lemaniae (C. Agardh) Drouet & Daily</i>	G	Fr	2
UP/ACP04	Nostocales	Nostocaceae	<i>Nostoc sp</i>	G	Fr	2
28	Nostocales	Nostocaceae	<i>Anabaena sp.</i>	G	Fr	2
UP/ACP04	Nostocales	Rivulariaceae	<i>Rivularia sp.</i>	G	Fr	2
CHLOROPHYTAS						
UP/ACP04	Volvocales	Volvocaceae	<i>Eudorina sp.</i>	G	Fr	2
UP/ACP04	Volvocales	Volvocaceae	<i>Pleodorina californica Shaw</i>	G	Fr	2
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox aureus Ehrenberg</i>	G	Fr	2
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox cf. perglobator Powers</i>	G	Fr	2
UP/ACP04	Volvocales	Volvocaceae	<i>Volvox cf. tertius Meyer</i>	G	Fr	2
28	Volvocales	Volvocaceae	<i>Volvox sp.</i>	G	Fr	2
UP/ACP04	Zygnematales	Closteriaceae	<i>Closterium cf. tortum Griffith</i>	G	Fr	2
28	Zygnematales	Desmidiaceae	<i>Arthrodesmus sp.</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium cf. contractum Kirchner</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium cf. moniliforme (Turpin) Ralfs</i>	G	Fr	1(28), 2
28	Zygnematales	Desmidiaceae	<i>Cosmarium sp.</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Cosmarium sp1</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Desmidium baileyi var. baileyi fo. tetragonum Nordstedt</i>	G	Fr	1(28), 2
28	Zygnematales	Desmidiaceae	<i>Desmidium sp.</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias foliacea Bailey</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias laticeps Nordstedt</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias radiata Hassall</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Micrasterias radiosa var. ornata fo. elegantior G.S. West</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium cf. javanicum (Gutwinski) Groenblad</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium planum (Wolle) West & West</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Spondylosium pulchrum (Bailey) Archer</i>	G	Fr	1(28), 2
28	Zygnematales	Desmidiaceae	<i>Stauranthus sp.</i>	G	Fr	1(28), 2
9	Zygnematales	Desmidiaceae	<i>Staurastrum anatinum</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. connatum (Lundell) Roy & Bissett</i>	G	Fr	1(28), 2

**Table 2-9. List of Species of Flora that Should Lost by an Increase in of the Salinity
in the Lakes Gatun and Miraflores.**

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. subcornutum</i> De Toni	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum cf. wolleanum</i> Butler ex Wolle	G	Fr	1(28), 2
9	Zygnematales	Desmidiaceae	<i>Staurastrum chaetoceros</i> (Schroed.) Smith	G	Fr	1(28), 2
UP/ACP04, 9	Zygnematales	Desmidiaceae	<i>Staurastrum leptocladum</i> Nordstedt	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum rotula</i> Nordstedt	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum rotula</i> Nordstedt	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp.</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp1</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp10</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp11</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp12</i>	G	Fr	1(28), 2
UP/ACP04	Zygnematales	Desmidiaceae	<i>Staurastrum sp13</i>	G	Fr	1(28), 2
BACILLARIOPHYTA					Fr	
UP/ACP04	Biddulphiales	Biddulphiaceae	<i>Biddulphia</i> sp	G	Fr	2
UP/ACP04	Aulacoseirales	Aulacoseiraceae	<i>Aulacoseira ambigua</i> (Grunow) Simonsen	G	Fr	2
UP/ACP04	Aulacoseirales	Aulacoseiraceae	<i>Melosira granulata</i> (Ehrenberg) Ralfs	G	Fr	2
UP/ACP04	Chaetocerotales	Acanthocerataceae	<i>Acanthoceras zachariasii</i> (Brun) Simonsen	G	Fr	2
28	Chaetocerotales	Attheyaceae	<i>Attheya</i> sp.	G	Fr	1(28).2
UP/ACP04	Coscinodiscales	Hemidiscaceae	<i>Actinocyclus</i> sp	G	Fr	2
UP/ACP04	Fragilariales	Fragiliaceae	<i>Asterionella formosa</i> Hassall	G	Fr	2
UP/ACP04	Fragilariales	Fragiliaceae	<i>Synedra acus</i> Kützing	G	Fr	2
28	Fragilariales	Fragiliaceae	<i>Synedra</i> sp.	G	Fr	1(28), 2
UP/ACP04	Meloseirales	Hyalodiscaceae	<i>Hyalodiscus</i> sp.	G	Fr	2
UP/ACP04	Meloseirales	Hyalodiscaceae	<i>Melosira cf. lineata</i> (Dillwyn) Agardh	G	Fr	2
UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Dactyliosolen fragilissimus</i> (Bergon) G.R. Hasle	G	Fr	2
28	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia</i> sp.	G	Fr	1(28), 2
28	Thalassionematales	Stephanodiscaceae	<i>Cyclotella</i> sp.	G	Fr	1(28), 2
28	Thalassionematales	Stephanodiscaceae	<i>Cyclotella stelligera</i> (Cleve & Grunow) Van Heurck	G	Fr	1(28), 2
UP/ACP04	Thalassiphysales	Catenulaceae	<i>Amphora</i> sp	G	Fr	2
CHYSOPHYTA					Fr	
28	Chromulinales	Dinobryaceae	<i>Chrysococcus</i> sp.	G	Fr	1(28), 2
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon bavaricum</i> Imhof	G	Fr	2
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon cf. sertularia</i> Ehrenberg	G	Fr	2
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon cf. sociale</i> Ehrenberg	G	Fr	2
UP/ACP04	Chromulinales	Dinobryaceae	<i>Dinobryon</i> sp	G	Fr	2
UP/ACP04	Mischocccales	Centritactaceae	<i>Centritractus belanophorus</i> Lemmermann	G	Fr	2
DINOPHYTA					Fr	
UP/ACP04	Gonyaulacales	Ceratiaceae	<i>Ceratium hirundinella</i> (O.F. Müller) Bergh	G	Fr	2
28	Peridiniales	Peridiniaceae	<i>Peridinium umbonatum</i> F. Stein	G	Fr	1(28), 2
UP/ACP04	Phytodiniales	Phytodiniaceae	<i>Dinococcus bicornis</i> (Woloszynska) Fott	G	Fr	2

**Table 2-9. List of Species of Flora that Should Lost by an Increase in of the Salinity
in the Lakes Gatun and Miraflores.**

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
EUGLENOPHYTA					Fr	
UP/ACP04		Euglenaceae	<i>Euglena sp</i>	G	Fr	2
UP/ACP04		Euglenaceae	<i>Euglena sp1</i>	G	Fr	2
UP/ACP04		Euglenaceae	<i>Phacus cf. pleuronectes (O.F.M.) Duj Fa</i>	G	Fr	2
UP/ACP04		Euglenaceae	<i>Trachelomonas ensifera fo. dentifera Prescott</i>	G	Fr	2
AQUATIC MACROPHYTAS						
51, 32		Marsiliaceae	<i>Marsilea polycarpa</i> Hook. & Grev.	G	Fr	2
32		Pontederiaceae	<i>Pontederia rotundifolia</i> L. f.	G	Fr	2
25		Asteraceae	<i>Pluchea odorata</i> (L.) Cass.	G	Fr	2
51		Poaceae	<i>Gynerium sagittatum</i> (Aubl.) Beauv.	G	Fr	2
25		Malvaceae	<i>Pavonia sessiliflora</i> Kunth	P*	T, Fr	1(25)
25		Malvaceae	<i>Pavonia preslii</i> Standl.	A*	Fr	1(25)

Criteria Values:

1: Criteria of the author of the article, who consider that these species should invaders if the salinity of the Gatun Lake increase to 11ppt if pumping sea water to the lake.

2: Specie reported to grow only in fresh water

Fr: Freshwater; T: Terrestrial

*: species from fresh water environments (Atlantic and Pacific sides)

**: Species tipical from fresh water habitats that should be in Gatun Lake and can be affected by any salinity increase.

Note: Number closed in parenthesis correspond to the reference used to separate species that should lost from the lakes by salinity changes or should invader the lakes by salinity increasing.

Table 2-10. List of Marine Species that Could Invade the Gatun and Miraflores by an Increase of Salinity.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
CYANOPHYTAS						
45	Oscillatoriales	Oscillatoriaceae	<i>Sirocoleum kurzii</i> (Zeller) Gomont	A, P	Fr, Ma	1(45)
45	Oscillatoriales	Phormidiaceae	<i>Porphyrisiphon miniatus</i> (Hauck) Drouet	A, P	Ma	1(45)
CHLOROPHYTAS						
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium kernerii</i> Stockmayer	A	Ma	1(45)
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium riparium</i> (Roth) Harvey	P, A	Ma	1(45)
45	Cladophorales	Cladophoraceae	<i>Rhizoclonium riparium</i> var. <i>implexum</i> (Dillwyn) Rosenvinge	P, A	Ma	1(45)
45	Ulvales	Gayraliaceae	<i>Gayralia oxysperma</i> (Kützing) K.L. Vinogradova ex Scagel et al.	A	Ma	1(45)
45	Ulvales	Ulvaceae	<i>Enteromorpha lingulata</i> J. Agardh	A	Ma	1(45)
45	Ulvales	Ulvaceae	<i>Ulva compressa</i> Linnaeus	A	Ma	1(45)
45	Ulvales	Ulvaceae	<i>Ulva lactuca</i> Linnaeus	A	Ma	1(45)
45	Ulvales	Ulvaceae	<i>Ulva paradoxa</i> C. Agardh	A	Ma	1(45)
45	Ulvales	Ulvaceae	<i>Ulva prolifera</i> O.F. Müller	A	Ma	1(45)
BACILLARIOPHYTAS						
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia behrei</i> Hustedt	P	Ma	1(28)
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia cf ventricosa</i> Kitton	P	Ma	1(28)
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia lorenziana</i> var. <i>incerta</i> Grunov	P	Ma	1(28)
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia sigma</i> (Kützing) W. Smith	P	Ma	1(28)
UP/ACP04	Bacillariales	Bacillariaceae	<i>Nitzschia sp1</i>	P	Ma	1(28)
UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia acuminata</i> (H. Peragallo) H. Peragallo	P	Ma	1(43)
UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia bergenii</i> H. Pér.	P	Ma	1(43)
UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia hyalina</i> Ostenfeld	P	Ma	1(43)
43, UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia imbricata</i> Brightwell	P, A	Ma	1(43)
UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia pungens</i> Cleve-Euler	P	Ma	1(43)
43, UP/ACP04	Rhizosoleniales	Rhizosoleniaceae	<i>Rhizosolenia setigera</i> Brightwell	P	Ma	1(43)
XANTHOPHYTA						
45	Vaucherales	Vaucheriacae	<i>Vaucheria dichotoma</i> (Linnaeus) Martius	A	Ma	1(45)

Criteria Values:

1: Criteria of the author of the article, who consider that these species should invade

if the salinity of the Gatun Lake increase to 11ppt if pumping sea water to the lake.

2: Specie reported to grow only in fresh water

G: Gatun Lake; M: Miraflores Lake; A: Atlantic side of the Panama Canal; Fr: Freshwater; Ma: Marine

T: Terrestrial

Note: Number closed in parenthesis correspond to the reference used to separate species that should lost from the lakes by salinity changes or should invader the lakes by salinity increasing.

Table 2-11. Species of Fauna That Could Lost by an Increase in of the Salinity From 0.5 to 15 0/00 in the Lakes Gatun and Miraflores.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
MOLLUSC						
48, 51, UP/ACP04	Neotaenioglossa	Thiaridae	<i>Melanoides tuberculata</i> (Muller, 1774)	G, M*	Fr	1(48)
48	Architaenioglossa	Ampullariidae	<i>Pomacea flagellata</i> Say, 1827	G	Fr	1(48)
UP/ACP04	Unionoidea	Unionidae	<i>Anodonta luteola</i> (Lea, 1858)	G	Fr	1(48)
PLANKTONIC CRUSTACEANS						
CLADOCERA						
7, 22, 44	Diplostraca	Bosminidae	<i>Bosminopsis deitersi</i> Richard, 1895	G, M*	Fr	1(48)
7, 22, 44	Diplostraca	Bosminidae	<i>Bosmina longirostris</i> (O. F. Mueller, 1785)	G	Fr	1(48)
44	Diplostraca	Bosminidae	<i>Bosmina longispina</i> Leydig, 1860	G	Fr	2
7, 9, 22, 44	Diplostraca	Daphniidae	<i>Ceriodaphnia cornuta</i> Sars, 1885	G	Fr	1(48)
44	Diplostraca	Chydoridae	<i>Chydorus eurynotus</i> Sars	G	Fr	1(48)
44	Diplostraca	Chydoridae	<i>Chydorus sphaericus</i> (O. F. Mueller, 1785)	G	Fr	1(48)
22, 44	Diplostraca	Daphniidae	<i>Moina micrura</i> Kurz, 1874	G, M*	Fr	1(48)
7, 22, 44	Diplostraca	Daphniidae	<i>Moina minuta</i> Hansen, 1899	G, M*	Fr	1(48)
7, 22, 44	Diplostraca	Sididae	<i>Diaphanosoma brachyurum</i> (Lievin, 1848)	G, M*	Fr	1(48)
COPEPOD						
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops albidus</i> Jurine	G, M*	Fr	1(48)
44	Cyclopoida	Cyclopidae	<i>Cyclops dentimanus</i> Marsh	G, M*	Fr	1(48)
22, 44, 1	Cyclopoida	Cyclopidae	<i>Cyclops leuckarti</i> Claus	G, M*	Fr	1(48)
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops serrulatus</i> Fischer	G, M*	Fr	1(48)
22, 44	Cyclopoida	Cyclopidae	<i>Cyclops tenuis</i> Marsh	G, M*	Fr	1(48)
44	Cyclopoida	Cyclopidae	<i>Cyclops ater</i> Herrick	M	Fr	1(48)
22, 44, 1	Cyclopoida	Cyclopidae	<i>Cyclops panamensis</i> Marsh	M	Fr	1(48)
44	Cyclopoida	Cyclopidae	<i>Cyclops phaleratus</i> Koch	M	Fr	1(48)
44, 1	Cyclopoida	Cyclopidae	<i>Cyclops prasinus</i> Fischer	M	Fr	1(48)
22, 44, 1	Calanoida	Diaptomidae	<i>Diaptomus leoninicollinus</i> Marsh	G	Fr	1(48)
9, 44, 1	Calanoida	Diaptomidae	<i>Diaptomus gatunensis</i> Marsh	G, M*	Fr	1(48)
44, 1	Calanoida	Diaptomidae	<i>Diaptomus marshi</i> Juday	G	Fr	1(48)
FRESHWATER FISHES						
51	Characiformes	Characidae	<i>Colossoma macropomum</i> (Cuvier, 1818)	G	Fr	3
85	Characiformes	Characidae	<i>Compsura gorgonae</i> (Evermann & Goldsborough, 1909)	G	Fr	2, 4
88	Characiformes	Characidae	<i>Creagrutus affinis</i> Steindachner, 1880	G	Fr	2, 4
51	Characiformes	Characidae	<i>Cyphocharax magdalena</i> (Steindachner, 1878)	G	Fr	2, 4
85, 60	Characiformes	Characidae	<i>Hyphephobrycon panamensis</i> Durbin, 1908	G	Fr	2, 4
85, 60	Characiformes	Characidae	<i>Roeboides guatemalensis</i> (Günther, 1864)	G	Fr	2, 4
UP-ACP04	Characiformes	Characidae	<i>Astyanax orthodus</i> Eigenmann, 1907	G, M*	Fr	2, 4
UP-ACP04	Characiformes	Characidae	<i>Brycon behreae</i> Hildebrand, 1938	G, M*	Fr	2, 4
86, 51	Characiformes	Characidae	<i>Brycon chagrensis</i> (Kner, 1863)	G, M*	Fr	2, 4
60, 88	Characiformes	Characidae	<i>Brycon petrosus</i> Meek & Hildebrand, 1913	G, M*	Fr	2, 4
60, 51	Characiformes	Characidae	<i>Roeboides occidentalis</i> Meek & Hildebrand, 1916	G, M*	Fr	2, 4

Table 2-11. Species of Fauna That Could Lost by an Increase in of the Salinity From 0.5 to 15 0/00 in the Lakes Gatun and Miraflores.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY	HABIT	CRITERIA
UP-ACP04	Characiformes	Characidae	<i>Roeboides ilseae</i> Bussing, 1986	M	Fr	2, 4
88	Gymnotiformes	Hypopomidae	<i>Brachyhypopomus brevirostris</i> (Steindachner, 1868)	G	Fr	2, 4
UP-ACP04	Perciformes	Cichlidae	<i>Archocentrus nigrofasciatus</i> (Günther, 1867)	G, M*	Fr	3
85, 51	Perciformes	Cichlidae	<i>Cichla ocellaris</i> Bloch & Schneider, 1801	G	Fr	2, 4
UP-ACP04	Perciformes	Cichlidae	<i>Mesonauta festivus</i> (Heckel, 1840)	G	Fr	3
86, 51	Perciformes	Cichlidae	<i>Oreochromis niloticus niloticus</i> (Linnaeus, 1758)	G	Fr	3
60, 51	Siluriformes	Heptapteridae	<i>Rhamdia quelen</i> (Quoy & Gaimard, 1824)	G	Fr	2, 4
51	Siluriformes	Loricariidae	<i>Hypostomus panamensis</i> (Eigenmann, 1922)	G	Fr	2, 4
AQUATIC INSECTS						
46	Diptera	Culicidae	<i>Anopheles triannulatus</i> (Neiva and Pinto, 1922)	G	Fr	1(46), 5
46	Diptera	Culicidae	<i>Mansonia dyari</i> Belkin, Heinemann and Page	G	Fr	1(46), 5
46	Diptera	Culicidae	<i>Mansonia titillans</i> (Walker, 1848)	G	Fr	1(46), 5
46	Diptera	Culicidae	<i>Mansonia leperi</i> Boreham.	G	Fr	1(46), 5
46	Diptera	Culicidae	<i>Mansonia pseudotitillans</i> (Theobald)	G	Fr	1(46), 5
46	Diptera	Culicidae	<i>Uranotaenia lowii</i> Theobald	G	Fr	1(46), 5

Criteria Values:

- 1: Criteria of the author of the article, who consider that these species should invaders if the salinity of the Gatun Lake increase to 11ppt if pumping sea water to the lake.
- 2: Specie reported to grow only in fresh water
- 3: Exotic specie with Economic importance that maybe affected by marine depredator that invade the lakes by salinity increase
- 4: Primary specie (the primary species should be affected with the salinity increase because his life cycle is completed in freshwater environments)
- 5: Medical importace specie that should disappear.

G: Gatun Lake; M: Miraflores Lake; Fr: Freshwater

*: These species probably not are able to resist a increase on salinity above of the salinity recorded in Miraflores Lake.

Note: Number closed in parenthesis correspond to the reference used to separate species that should lost from the lakes by salinity changes or should invader the lakes by salinity increasing.

Table 2-12 A. List of Species That Could Invade Gatún and Mirafl ores Lakes.

SOURCE	ORDER	FAMILY	SPECIE	LOCALITY OF ORIGIN	LOCALITY THAT SHOULD INVADE	HABIT	CRITERIA
MOLLUSC-BIVALVS							
48	Myoida	Teredinidae	<i>Psiloteredo Miraflora</i> (Bartsch, 1922)	ML	M	BMa	1(48)
48	Mytiloida	Mytilidae	<i>Brachidontes exustus</i> Linné	GL	G	BMa	1(48)
3	Mytiloida	Mytilidae	<i>Brachidontes puntarenensis</i> (Pilsbry y Lowe, 1932)	P	ML, M	BMa	1(48)
3	Mytiloida	Mytilidae	<i>Brachidontes seMLilaevius</i> (Menke, 1894)	P	ML, M	BMa	1(48)
48	Mytiloida	Mytilidae	<i>Brachidontes sp.1</i>	ML	M	BMa	1(48)
48	Mytiloida	Mytilidae	<i>Brachidontes sp.2</i>	ML	M	BMa	1(48)
48	Mytiloida	Mytilidae	<i>Mytella striGLata</i> (Hanley, 1843)	ML	M	BMa	1(48)
50	Mytiloida	Mytilidae	<i>Mytilus zeteki</i> L. G. Hertlein & GL. D. Hanna	P	ML, M	BMa	1(48)
48, 21	Ostreoida	Ostreidae	<i>Ostrea palmula</i> Carpenter	ML	M	BMa	1(48)
48	Pterioida	Isognomonidae	<i>Isognomon bicolor</i>	P	ML, M	BMa	1(48)
48	Veneroida	Dreissenidae	<i>Mytilopsis leucophaetus</i> (Conrad, 1831)	GL	G	BMa	1(48)
48	Veneroida	Dreissenidae	<i>Mytilopsis sallei</i> Recluz	GL, ML	G, M	BMa	1(48)
48	Veneroida	Dreissenidae	<i>Mytilopsis zeteki</i> Hertlein & Hanna, 1949	ML	M	BMa	1(48)
MOLLUSC-GLASTROPODS							
48	Caenogastropoda	Muricidae	<i>Eupleura nitida</i> (Broderip, 1833)	ML	M	BMa	1(48)
48	Caenogastropoda	Thaidinae	<i>Thais kiosquiformis</i> (Duclos, 1832)	ML	M	BMa	1(48)
48	Caenogastropoda	Thaidinae	<i>Thais sp.2</i>	ML	M	BMa	1(48)
48	Neritopsina	Neritidae	<i>Neritina latissima</i> Broderip, 1833	ML	M	BMa	1(48)
48	Neritopsina	Neritidae	<i>Neritina piratica</i> (Russell, 1940)	GL	G	BMa	1(48)
48	Neritopsina	Neritidae	<i>Neritina reclivata</i> (Say, 1822)	GL	G	BMa	1(48)
48	Neritopsina	Neritidae	<i>Neritina sp.1</i>	ML	M	BMa	1(48)
BRYOZOANS							
21	Anasca	Bugulidae	<i>Bugula neritina</i> (Linnaeus, 1758)	P, A	ML, M	Ma	1(42)
42	Anasca	Bugulidae	<i>Bugula stolonifera</i> Ryland, 1960	P, A	ML, M	Ma	1(42)
42	Cheilostomata	Electridae	<i>Electra monostachys</i> Busk	P, A	ML, M	Ma	1(42)
21	Cheilostomata	Membraniporae	<i>Membranipora savartii</i> Audouin	P, A	ML, M	BMa	1(42)
42	Cheilostomata	Membraniporae	<i>Sinoflustra annae</i> Osburn	P, A	ML, M	BMa	1(42)
CRUSTACEANS							
49	Decapoda	Palaemonidae	<i>Leander paulensis</i> OrtMann	GL	G	Ma	1(49)
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium olfersii</i> Wiegmann	GL	G	Ma	1(49)
49, 91	Decapoda	Palaemonidae	<i>Macrobrachium panamense</i> Rathbun, 1912	ML	ML, M	Fr	1(49)
49, 91	Decapoda	Palaemonidae	<i>Palaemon schmitti</i> Holthuis	ML	ML, M	Ma	1(49)
49	Decapoda	Parthenopidae	<i>Heterocrypta occidentalis</i> (Dana, 1854)	ML	ML, M	Ma	1(49)
49	Decapoda	Xanthidae	<i>Eurypanopeus confragosus</i> Rathbun	ML	ML, M	Ma	1(49)
49	Decapoda	Xanthidae	<i>Eurypanopeus dissimilis</i> (Benedict and Rathbun, 1891)	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>Hexapanopeus caribbaeus</i> (Stimpson, 1871)	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>Hexapanopeus paulensis</i> Rathbun	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>MLenippe nodifrons</i> Stimpson	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>Panopeus herbstii</i> H. Milne-Edwards	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>Panopeus rugosus</i> A. Milne-Edwards	GL	G	Ma	1(49)
49	Decapoda	Xanthidae	<i>Pilumnus dasypodus</i> Kingsley	GL	G	Ma	1(49)
49	Decapoda	GLrapsidae	<i>Pachygrapsus GLracilis</i> (De Saussure, 1858)	GL	G	Ma	1(49)
49	Decapoda	GLrapsidae	<i>Pachygrapsus transversus</i> (GLibbes, 1850)	ML	M	Ma	1(49)
PLANKTONIC MARINE COPEPODS							
22	Calanoida	Acartiidae	<i>Acartia lilljeborgi</i> Giesbrecht	A, P	GL, G, ML,M	Ma	1(22)
22	Calanoida	Acartiidae	<i>Acartia spinata</i> Esterly	A	GL, G,	Ma	1(22)
22, 31	Calanoida	Acartiidae	<i>Acartia tonsa</i> Dana	A, P	GL, G, ML,M	Ma	1(22)

22	Calanoida	Acartiidae	<i>Acartia lilljeborgii</i> Giesbrecht	A, P	GL, G, ML,M	Ma	1(22)
22	Harpacticoida	Euterpinidae	<i>Euterpina acutifrons</i> (Dana) 1847	A, P	GL, G, ML,M	Ma	1(22)
22	Calanoida	Paracalanidae	<i>Paracalanus crassirostris</i> DahlF	A, P	GL, G, ML,M	Ma	1(22)
MARINE FISHES							
55	Anguilliformes	Ophichthidae	<i>Myrophis punctatus</i> Lütken, 1852	A	GL, G,	Ma	Reported from fresh water in Nicaragua, Costa Rica, and Mexico. Speckled worm eel
55	Batrachoidiformes	Batrachoididae	<i>Batrachoides pacifici</i> (GLünther, 1861)	P	ML, M	Ma	Reported to Eastern Pacific: Panama Canal to northern of Peru. Sometimes enters fresh water. Pacific toadfish. Dawson and Party, Miraflores Locks. Compatible with distributional range Johannes, R.E., 48 km upcoast of Panama City, Mouth of Rio Caimito,
55	Beloniformes	Belonidae	<i>Strongylura timucu</i> (Walbaum, 1792)	A	GL, G,	Ma	Adults found on reef flats, in lagoons, or in freshwater. Timucu.DAWSON AND JONES, COLON RIO CHAGRES, Compatible with distributional range. hunting macrofauna (predator)
55	Clupeiformes	Engraulidae	<i>Anchoa hepsetus</i> (Linnaeus, 1758)	A	GL, G,	Ma	Able to tolerate a wide range of salinities, from hypersaline to almost fresh, forms dense schools. Broad-striped anchovy.
55	Clupeiformes	Engraulidae	<i>Anchoa lucida</i> (Jordan & Gilbert, 1882)	P	ML, M	Ma	Occurs in coastal waters, but most often recorded from bays, lagoons and estuaries, thus able to tolerate lowered salinities. Forms schools. Bright anchovy. STRI LABORATORY; C.E. DAWSON, WEST SIDE OF PEDRO MIGUEL LOCKS,
55	Clupeiformes	Engraulidae	<i>Anchoa panamensis</i> (Steindachner, 1877)	P	ML, M	Ma	Occurs in coastal waters, but most often recorded from bays, lagoons and estuaries, thus able to tolerate lowered salinities. Panama anchovy. Peripheral specie.
86, 71	Elopiformes	Albulidae	<i>Megalops atlanticus</i> Valenciennes, 1847	P, A, GL	G, M	Ma	Inhabit coastal waters, bays, estuaries. Peripheral
94	Perciformes	Blenniidae	<i>Lupinoblennius dispar</i> Herre, 1942	ML	M	Ma	This species migrated fromL the atlantic side and was collected in Gatun and Miraflores Locks.
55	Perciformes	Carangidae	<i>Oligoplites saurus</i> (Bloch & Schneider, 1801)	A, ML	M	Ma	Found inshore, usually along sandy beaches, in bays and inlets, enters estuaries and fresh water and prefers turbid water. Leatherjack. DAWSON AND JONES, Collected in Rio Chagres, Canal Zone area Peripheral. Specie hunting macrofauna (predator)
62	Perciformes	Eleotridae	<i>Eleotris picta</i> Kner & Steindachner, 1863	ML	M	Ma, Fr	Demersal; catadromous, freshwater; brackish; marine environments. Appears to prefer estuarine freshwater tributaries, occurring in waters with a salinity range of 0 to 19 ppt. Spinycheek sleeper

62	Perciformes	Eleotridae	<i>Eleotris pisonis</i> (Gmelin, 1789)	ML	M	Ma, Fr	Demersal; freshwater; brackish waters. more abundant near the coast and only large individuals are found upstream. Spotted sleeper
55	Perciformes	Gerreidae	<i>Eucinostomus argenteus</i> Baird & Girard, 1855	A	GL, G	Ma	Enters freshwater and the juveniles are encountered in lagoons of mangroves. Silver mojarra.
51	Perciformes	Gerreidae	<i>Eugerres plumieri</i> (Cuvier, 1830)	GL	GL, G	Ma	Often entering a considerable distance into freshwaters. Inhabits shallow coastal waters and common in brackish waters. Striped Mojarra
73, 94	Perciformes	Gobiidae	<i>Lophogobius cyprinoides</i> (Pallas, 1770)	A, ML	M	Ma	demersal; freshwater; brackish; marine 1(94) Inhabits tidal creeks, mangroves and other quiet, fresh to fully saline coastal waters.
UP-ACP04, 51	Perciformes	Lutjanidae	<i>Lutjanus argentiventralis</i> (Peters, 1869)	ML	M	Br, Ma	Tolerant to freshwaters and Found in inshore reef areas over hard bottom until at least 60 m depth. Yellow snapper. Peripheral specie.
55, 51	Perciformes	Mugilidae	<i>Mugil curema</i> Valenciennes, 1836	P	ML, M	Ma	Sometimes penetrates rivers. Collected at an stream at iron bridge on Canoas-Puerto Armuelles road. White Mullet.
51	Perciformes	Centropomidae	<i>Centropomus armatus</i> GLill, 1863	GL	G	Ma	Armed snook. Collected in Rio Salado at bridge on road about 7 mi. S of Las Tablas. Peripheral specie.
UP-ACP04	Perciformes	Centropomidae	<i>Centropomus nigrescens</i> Günther, 1864	ML	M	Br, Ma	occurs in estuaries and fresh water. Black snook.
88	Perciformes	Centropomidae	<i>Centropomus parallelus</i> Poey, 1860	GL	G	Ma	Inhabits coastal waters, estuaries and laGLoons, penetrating into freshwater. Collected in Barro Colorado Island (BCI). Fat snook . Peripheral specie
55	Siluriformes	Ariidae	<i>Hexanemichthys seemanni</i> (Günther, 1864)	P	ML, M	Ma	Common in coastal marine and brackish waters and Inhabits medium and large rivers to an elevation of at least 25 m. Tete sea catfish. Peripheral specie.

Criteria Values:

1: Criteria of the author of the article, who consider that these species should invaders if the salinity of the Gatun Lake increase until 11ppt if pumping sea water to the lake.

GL: Gatun Lake; ML: Miraflores Lake; A: Atlantic side of the Panama Canal; P: Pacific side of the Canal; Fr: Freshwater; Ma: Marine; T: Terrestrial

Br: Brackish water

Note: The coMLMLents in text to justify the invader roll were download from FishBase Organization.

<http://www.fishbase.org/ML/search.cfML>

ANNEX 2

BIBLIOGRAPHY CONSULTED

No.	Documento	Author	Date	Theme	Area of Study	Source	Key words	Utility Level
1	Report on Fresh-water Copepoda from Panama, with descriptions of New Species	Marsh, Dwight C.	1913	Copepodos	Sistematica, Zooplanton	Smithsonian Miscellaneous Collection Vol. 61, No.3	Copepodo, zooplancton, Agua dulce	Mediana
2	New Decapod Crustaceans from Panama	Rathbun, Mary J.	1912	Crustáceos	Sistematica	Smithsonian Miscellaneous Collection Vol. 59, No.13	Macrobrachium, Pseudothelphusa, Leptodius	Mediana
3	Moluscos del Litoral Arenoso de la Bahía de Panamá	Garcés B., Humberto	1993	Moluscos	Infrafauna Malacológica	Scientia (Panamá), Vol. 8 No.1, 171-189	Bahía de Panamá, Litoral Arenoso, Moluscos	Buena
4	Estudio del Sedimento de Una Playa Arenosa Fangosa en el Pacífico de Panamá (Bique).	Martínez Vega, Victor & Villalaz Hanzel	1983	Análisis de Sedimentos Areno Fangosos	Granulometría e Hidrometría de Sedimentos	ConCiencia Vol.X, No.1	Sedimentos, Playa Areo Fagosa, Granulometría, Hidrometría	Buena
5	Diversidad de las Comunidades de Peces Juveniles en Algunos Estuarios del Golfo de Panamá	Martínez Vega, Victor, Briceño J. & Del Rosario, J.B.	1983	Peces	Ecología de Peces	ConCiencia Vol.X, No.1	Peces Juveniles, Estuarios, Golfo de Panamá	Buena
6	Observaciones Preliminares de la Determinación del Estado de la Maduración Sexual en la Anchoa panamensis (Steidachner)	Tejada, Julio; Sandoval, R. Goodyear, R. & Victor Martínez V.	1983	Peces	Fisiología de Peces	ConCiencia Vol.X, No.2	Anchoa panamensis, Maduración sexual, fisiología, engráulidos	solo referencia
7	Dinámica de los Cladóceros Limneticos en el Lago Gatún	Miguelena De Leon, Bruno O.	1982	Crustáceos	Cladóceros	ConCiencia Vol. IX, No.1	Cladóceros, Lago Gatún, Zooplanton	Buena
8	Peces del Golfo de Montijo, Provincia de Veraguas, Republica de Panama: Inventario Preliminar	Vega, Angel J.	1994	Peces	Inventario de Peces	Scientia (Panamá), Vol.9 No.2, 33-38	Peces, Golfo de Montijo, Inventario, Estuarios, taxonomía	solo referencia
9	Composición y Abundancia de Copepodos y Rotíferos Limneticos en el Lago Gatún.	Garcés B., Humberto	1982	Copepodos y Rotíferos	Biología del Zooplanton	ConCiencia Vol. IX, No.3	Zooplanton, Copepodos, rotíferos, Lago Gatún	Buena
10	Listas de Algunas Especies de Importancia Económica.	Ministerio de Comercio e Industrias	S/F	Peces	Especies Importancia económica	Departamento de Investigación y Evaluación Pesquera.	Peces, Almejas, Langostas, camarones, MICI,	solo referencia
11	Interceanic Sea-Level Canal: Effects on Fish Fauna.	Topp, Robert W.	1969	Peces	Ecología de Peces	Science, Vol.165. 1969	Canal a Nivel, Zoológica, Peces	Buena
12	Taxonomía del Género Pomacea sp.	The Apple Snail Web Site	2004	Moluscos	Descripción taxonómica de especies	http://www.applesnail.net	Pomacea, taxonomía, sinónimos, especies.	Buena

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No.	Documento	Author	Date	Theme	Area of Study	Source	Key words	Utility Level
13	Situación de los Manglares en Panamá	Osorio, Orlando O.	1994	Ecosistema de Manglar	Los Manglares en Panamá	El Ecosistema de Manglar en America Latina y la Cuenca del Caribe: Su manejo y Conservación. Suman, Daniel O. Editor	Distribución, Características del manglar, mar Caribe, Océano Pacifico	solo referencia
14	List of Fresh Water Fishes for Panama	Fish Base organization	2004	Peces	Inventario de Peces	Froese, R. and D. Pauly. Editors. 2004. FishBase. World Wide Web electronic publication. www.fishbase.org, version (08/2004).	Peces, Panamá, nombres comunes	solo referencia
15	Pesca Artesanal y Repoblamiento de los Lagos de la Cuenca del Canal de Panamá.	Ministerio de Desarrollo Agropecuario (Mida)	??	Peces exóticos	Re poblamiento y pesca Artesanal	Dirección Nacional de Acuicultura	Pesca artesanal, repoblamiento, Lago Gatún, Lago Alhajuela	solo referencia
16	Sumario de Especies de Peces	Fish Base organization & Gobiidae.com	9/13/2004	Peces	Taxonomía y Biología de Peces	Froese, R. and D. Pauly. Editors. 2004. FishBase. World Wide Web electronic publication. www.fishbase.org, version (08/2004). Gobioid Research	Gobidos, Epinephelus, Taxonomía, ecología, biología.	solo referencia
17	Migración Masiva de un Camarón de Río Atyidae (<i>Atya crassa</i>), Como Consecuencia del Cierre del Río Bayano, República de Panamá.	Goodyear, Richard H., Martínez V., Victor y Juan B. Del Rosario	1982	Crustáceos	Migración de crustáceos.	ConCiencia Vol. IX No. 2	Migración, Camarón de río, Atya, río Bayano.	solo referencia
18	Report of Participating Scientist on Possible Effects of Sea Water Pumping on the Lake Gatun. Abstracts of papers	Engineering Division, Panama Canal Company	1975	Scientific reports	Zoo & Phyto communities	Sea Water Pumping Environmental Study Phase I. Panama Canal	Abstracts, biological Inventories, sea water, Gatun lake.	Buena
19	Ecology of Marine Fishes	Gordon, Malcom S. & Christopher A. Loretz	1974	Peces	Ecología de Peces	Sea Water Pumping Environmental Study Phase I. Panama Canal	Fish faunas, Possibles Impacts, salinity tolerance limits.	Buena
20	A Conceptual Study of The Effects on the Polychaete Fauna of Sea Water Pumping in the Panama Canal System	Fauchald, Kristian	1975?	Polychaetos	Biología e impactos en la Población de polichaetos	Sea Water Pumping Environmental Study Phase I. Panama Canal	Polichaetos, Mar Caribe, Océano Pacifico, impactos por los cambios de salinidad	Buena
21	Some considerations of the Effects of Sea Water Pumping on Fouling Organism	Cargo, David G.	1974	Fouling Organisms	Effects fo the sea Water on fouling organisms	Sea Water Pumping Environmental Study Phase I. Panama Canal	Fouling Organism, Invertebrates, salinity, bryozoans, endemics	Buena

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No.	Documento	Author	Date	Theme	Area of Study	Source	Key words	Utility Level
22	Potential Changes in the Zooplankton of Gatun Lake as a Consequence of Proposed Pumping of Sea Water.	Heinle, Donald R.	1974?	Zooplancton	Cambios del zooplancton por adición de Agua de Mar.	Sea Water Pumping Environmental Study Phase I. Panama Canal	Zooplancton, Copepodos, salinidad, Lago Gatún	Buena
23	Use of Sea Water Augmentation in the Gatun Lake-Panama Canal System: Recommendations for Water Quality Research. Final Report	Harriss, Robert C.	1974	Uso de Agua de Mar	Aumento en el uso del agua de mar en el Lago Gatun	Sea Water Pumping Environmental Study Phase I. Panama Canal	Agua de Mar, Lago gatún, Canal de Panamá	Buena
24	Possible Effects of Sea Water Introduction to the Habitats of Aquatic Insects in gatun Lake	Hogue, Charles L.	1974	Efectos del Agua de Mar en los Habitat de Insectos acuáticos	Insectos Acuáticos y su biología.	Sea Water Pumping Environmental Study Phase I. Panama Canal	Salinidad, Insectos Acuáticos, Hábitats	Buena
25	Shore Vegetation	Teas, Howard	1974?	Vegetación	Efectos de la Salinidad sobre la vegetación marginal	Sea Water Pumping Environmental Study Phase I. Panama Canal	Vegetación marginal, Agua de Mar, Canal de Panama, especies tolerantes	Buena
26	Sea Water Pumping Environmental Study. Gatun Lake Communities	Zaret, Thomas M.	1974?	Efectos del Agua de Mar en las comunidades del lago Gatun	Comunidades de zooplancton, fitoplancton, peces, moluscos, macrophytas.	Sea Water Pumping Environmental Study Phase I. Panama Canal	Comunidades, zooplancton, fitoplancton, peces, Lago Gatun.	Buena
27	The Effects of Salinity Changes on Microbial Activities	White, David C.	1974	Bacterias	Efectos de la Salinidad sobre la actividad microbiana	Sea Water Pumping Environmental Study Phase I. Panama Canal	Salinidad, actividad microbiana, Canal de Panama.	Buena
28	Freshwater Phytoplankton Community	Weers, Eleanor T.	1974?	Efectos del Agua de Mar	Comunidades de fitoplancton de agua dulce.	Sea Water Pumping Environmental Study Phase I. Panama Canal	Fitoplancton, Agua dulce, salinidad, Lago gatun, Canal de Panamá	Buena
29	Crustacean Ecology	Vernberg, F. John	1974	Crustáceos	Ecología de Crustáceos	Sea Water Pumping Environmental Study Phase I. Panama Canal	Ecología, crustáceos, Canal de Panamá.	Buena
30	A Comparison of the Maracaibo and Panama Canal System	Rodríguez, Giberto	1974	Ecología	Lago Maracaibo y Canal de Panamá	Sea Water Pumping Environmental Study Phase I. Panama Canal	Maracaibo, Canal de Panama, salinidad, Benthos, comunidades	Buena
31	Preliminare Observations on the Marine Zooplankton in the System with Recommendations for Future Research.	Reeve, M.R.	1974	Ecología	Zooplancton Marino	Sea Water Pumping Environmental Study Phase I. Panama Canal	Marine Zooplankton, Panama Canal.	Buena

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33	Salinity Considerations of Freshwater Fish of the Panama Canal System	Bozeman, E.L. & Dean, J.M.	1974?	Peces de agua dulce	Efectos de la salinidad en los peces de agua dulce	Sea Water Pumping Environmental Study Phase I. Panama Canal	Peces de agua dulce, Salinidad, Canal de Panama, ecosistema acuático, Lago gatun	Buena
34	Cross-Cordillera Exchange Mediated by the Panama Canal Increase the Species richness of Local Freshwater Fish Assemblages.	Smith, S.A., Bell, Graham & Eldredge Bermigham	2004	Intercambio Biotico	Riqueza de especies, Ecología	Proc. R. Soc. Lond. B. Doi:10.1098/rspb.2004.2796	Saturación, procesos locales y regionales, exclusión competitiva, riqueza de especies.	Buena
35	Peces de Agua Dulce de Panamá	Bermigham, E.; Castillo, a.; Aswani, V. & Gonzalez, R.	2001	Peces	Biología y Ecología de Peces	Panamá:Puente Biológico. Stanley Heckadon Moreno	Peces de agua dulce, migraciones, ríos embalses	Buena
36		La Pesca en Estuarios Panameños: Una Visión Histórica y Cultural desde la Bahía de Parita.	2001	Peces	Pesca en estuarios panameños histórica y culturalmente.	Panamá:Puente Biológico. Stanley Heckadon Moreno	Peces, estuarios, tradición, Bahía de Parita.	solo referencia
37	Los Moluscos y la Historia Natural de Panamá.	Fortunato, Helena	2001	Moluscos	Moluscos e historia natural	Panamá:Puente Biológico. Stanley Heckadon Moreno	Moluscos, historia natural, Taxonomía	solo referencia
38	Arrecifes y Peces de la Costa Pacífica Panameña: Una Región Biológica Única.	Robertson, Ross	2001	Arrecifes y Peces	Historia Natural	Panamá:Puente Biológico. Stanley Heckadon Moreno	Arrecifes, Peces, istmo de Panamá.	Buena
39	Primer Informe de la Riqueza y Estado de la Biodiversidad de Panamá.	Autoridad Nacional del Ambiente, ANAM.	2000	Biodiversidad	Peces de Agua Dulce y marinos	Autoridad Nacional del Ambiente, ANAM.	Peces de agua dulce y marinos, Flora de agua dulce.	solo referencia
40	Reunión de Expertos sobre el Impacto de la Introducción de Especies Exóticas en el Pacífico Sudeste, Problema de las Aguas de Lastre de los Buques: Informe de Panamá	Autoridad Marítima de Panamá, Autoridad nacional del Ambiente et al.	2003	Introducción de Especies Exóticas	Aguas de Lastre de los Buques.	Comisión Permanente del Pacífico Sur.	Especies exóticas, Aguas de Lastre, Panamá.	solo referencia
41	Probable Environmental Impact of Salinity Change on Marine Wood Borers.	Menzies, Robert J.	1974	Marine Borers	Changes in Salinity and its effects on marine Borers	Sea Water Pumping Environmental Study Phase I. Panama Canal	Marine borers, Panama Canal, salinity changes.	Buena
42	General Marine Invertebrates	Mariscal, Richard N.	1974?	Marine Invertebrates	Salinity changes and marine invertebrates	Sea Water Pumping Environmental Study Phase I. Panama Canal	Marine Invertebrates, salinity changes	Buena

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No.	Documento	Author	Date	Theme	Area of Study	Source	Key words	Utility Level
43	Possible Impact of Salinity Changes in the Panama Canal System on Marine Phytoplankton	Iverson, Richard L.	1974	Marine Phytoplankton	Salinity changes and marine phytoplankton	Sea Water Pumping Environmental Study Phase I. Panama Canal	Marine phytoplankton, Panama Canal system.	Buena
44	Freshwater Zooplankton	Hurlbert, Stuart H.	1974?	Zooplancton	Salinity changes and freshwater zooplankton	Sea Water Pumping Environmental Study Phase I. Panama Canal	Zooplankton, Salinity changes	Buena
45	Marine Plants	Humm, Harold, J.	1974?	Gatun Lake and Marine plants	Marine Plants how Invaders on Gatun Lake.	Sea Water Pumping Environmental Study Phase I. Panama Canal	Marine Plants, Invaders, Salinity Changes.	Buena
46	Projections on the Effects of the Salinization of Gatun Lake on Insects of Medical Importance.	Boreham, Melvin M.	1974?	Insects of medical Importance	Effects of Salinization on insects	Sea Water Pumping Environmental Study Phase I. Panama Canal	Insects, Medical importance, Gatun Lake, Salinization	Buena
47	Excavating Sponges as Fouling Organism	Bakus, Gerald J.	1974?	Sponges	Fouling Organism	Sea Water Pumping Environmental Study Phase I. Panama Canal	Sponges, Fouling organism, Ecology, Systematic, salinity.	Buena
48	The Mollusc of the Panama Canal	Greenberg, Michael J.	1974?	Mollusc	Species diversity and Distribution on the Panama Canal	Sea Water Pumping Environmental Study Phase I. Panama Canal	Mollusc, Panama Canal, distribution.	Buena
49	The Deacapod Crustacean Fauna of the Panama Canal and Adjacent Waters	Abele, Lawrence	1974?	Crustáceos	Ecological distribution, Decapod Fauna and salinity changes	Sea Water Pumping Environmental Study Phase I. Panama Canal	Decapod, Panama Canal, Adjacent Areas, salinity changes	Buena
50	Mollusks of The Tropical Eastern Pacific. Particularly from the Southern Half of the Panamic-Pacific Faunal Province (Panama to Peru). Panamic-Pacific Pelecypoda.	Olsson, Axel A.	1961	Molluscos	Taxonomía y distribución de Pelecípodos.	Paleontological Research Institution. Ithaca, N.Y.	Molluscos, Pelecípodos, Panamá, Perú.	solo referencia
51	El Inventario Biológico del Canal de Panamá. IV. El Estudio de Aguas Continentales y Entomológico.	Gutiérrez, R. Et al	1994	Estudio de las Aguas Continentales.	Inventario Biológico del Canal de Panamá.	Scentia (edición especial), Diciembre de 1995.	Inventario Biológico, Canal de Panamá, aguas dulces.	Buena
52	Mollusk from the Gulf of Panama Collected by R/V John Elliot Pillsbury, 1967.	Olsson, Axel A.	1971	Mollusks	Panamenian mollusk taxonomy	Studies in Tropical American Mollusks. Edited by Frederick M. Bayer & Gilbert L. Voss	Mollusk, Gulf of Panama, Taxonomy	solo referencia
53	The Conidae of the Pillsbury Expedition to the Gulf of Panama.	Nybakken, James	1971	Mollusks	Systematic of the Molluscan Genus Conus	Studies in Tropical American Mollusks. Edited by Frederick M. Bayer & Gilbert L. Voss	Mollusc, Conus, systematic and distribution, Gulf of Panama.	solo referencia

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54	New and Unusual Mollusk Collected by R/V John Elliot Pillsbury and R/V Gerda in the Tropical Western Atlantic.	Bayer, Fredrerick	1971	Mollusks	Description of new and rare mollusks.	Studies in Tropical American Mollusks. Edited by Frederick M. Bayer & Gilbert L. Voss	New and rare mollusk species.	solo referencia
55	El inventario Biológico del Canal de Panamá. I. El Estudio Marino	D'Croz, L., Martínez V. & Arosemena, G.	1994	Inventario Biológico	Áreas marinas del Caribe y Pacífico del Canal de Panamá.	Scentia (edición especial), Enero de 1994.	Bahía de Panamá, mar Caribe, Calidad del Agua, sedimentos, Arrecifes y comunidades coralinas, Manglares, Bentos, Peces, Macroinvertebrados	Buena
56	Los Manglares del Pacífico Centroamericano	Jiménez, Jorge A.	1995	Manglar	Biodiversidad de flora y fauna.	Universidad Nacional – INBio. Heredia.	Componente faunístico, flora del manglar.	solo referencia
57	Report on the Marine Fauna and Benthic Shelf-slope Communities of the Isthmian Region.	Bayer, Fredrick et al	1970	Biological Inventory	Invertebrates and Fishes.	Bioenvironmental and Radiological-Safety feasibility Studies Atlantic-Pacific Interoceanic Canal.	Sea level Canal, Invertebrates, fishes, Caribe sea, Pacific Ocean	Buena
58	Estudio de Impacto Ambiental Categoría III. Construcción de la Autopista Oeste de Acceso al Segundo Puente sobre el Canal de Panamá	Ambiente y Reforestación S.A.	2003	Ambiental	Evaluación de Impactos por la construcción de la Autopista Oeste.	Ministerio de Obras Públicas de Panamá.	Estudio de impactos, Puente sobre el canal de Panamá.	solo referencia
59	The Geographical Distribution of Freshwater Fishes in Panama	Loftin, Horace G.	1927	Peces	Distribución geográfica de los peces.	University Microfilms, Inc., Ann Arbor, Michigan.	Peces de agua dulce, Panamá, Chagres, Canal de Panamá.	Buena
60	A New Catalogue of the Fresh-Water Fishes of Panama.	Hildebrand, Samuel F.	1938	Peces	Taxonomía de Peces de agua dulce.	Zoological Series, Field Museum of Natural History vol. XXII, No.4	Peces de agua dulce, origen y distribucion.	solo referencia
61	Estudio de Impacto Ambiental Categoría III. Construcción de la Autopista de Acceso al Segundo Puente sobre el Canal de Panamá-SECCIÓN Este (Tramo IV)	Consultores en Ambiente y Tecnología S.A.	2003	Ambiental	Acceso al segundo puente sobre el Canal.	Ministerio de Obras Públicas de Panamá.	Inventario ambiental, Impactos.	solo referencia
62	Ocurrence of an Exotic Eleotrid Fish in Panama with Discussion of Probable origin and Mode of Introduction.	Dawsoon, C.E.	1973	Peces	Especies exóticas	Copeia, 1973, No.1	Esclusas de Miraflores, especies exóticas.	Buena

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63	Reproduction in the Yellow-Bellied Sea Nake (<i>Pelamis platurus</i>) from Panama: Field and Laboratory Observations.	Vallarino, Oscar & Weldon, Paul J.	1996	Snakes	Reproduction Biology Sea Snakes	Zoo Biology 15:00-00 (1996)	Sea Snakes, Reproduction	solo referencia
64	Central American Sea-Level Canal: Possible Biological Effects.	Rubinoff, Ira	1968	Ambiental	Possible Canal a Nivel y sus consecuencias.	Science, Vol. 161	biological experiment, Sea level.	Buena
65	A New Seven-spined Goby, <i>Gobiosoma(Austrogobius) polyporosum</i> , from the Pacific Coast of Panama	Dawson, C.E.	1969	Peces	Descripción de nuevas especies.	Copeia, 1969, No.3	New specie, gobidae, Coast area.	solo referencia
66	Plan de Manejo Integrado de Pesca y Acuicultura en Lagos, Lagunas y Embalses del Istmo Centroamericano.	Unidad Regional de Pesca y Acuicultura	2002	Acuicultura	Lagos, Lagunas y Embalses.	Sistema de la Integración Centroamericana. OSPESCA	Plan de manejo, Acuicultura, lagos, lagunas, Embalses.	solo referencia
67	Implicaciones Ecológicas de las transformaciones Geográficas Ocasionadas por la Construcción del Canal de Panamá.	De Alba, Georgina	???	Ambiental	Cuenca del Canal de Panamá	???????	Lago Gatún, Hydrilla, Implicaciones ecológicas, hierbs acuáticas, derrame.	solo referencia
68	Microalgas presentes en el Fitobentos Colectado en el Canal de Panamá (Esclusas de Pedro Miguel)	Pérez, María I. & Aguilar, Edilberto	2001	Microflora	Microalgas	Tecnociencia 2001, Vol.3 No.1	Microalgas, fitobentos, esclusas, diatomeas, clorofitas, cyanophyta, Bacillariophyceae.	Buena
69	Plantas Acuáticas de Panamá	Mendoza B., R. & Gonzalez, J.E.	1991	Plantas Acuáticas	Ecosistemas acuáticos	Plantas Acuáticas de Panamá. IRHE, EUPAN.	Pontederiaceae, Eichornia, jacinto Acuático.	Buena
70	Diatomeas Dulceacuicolas en Estanques de Cultivo Piscícola.	Soler, A., Sánchez, M. & Herrera, M.	1991	Diatomeas	Sistemática	Scenaria (Panamá), 1991, Vol.6 No.2, 55-105	Taxocenosis, Diatomeas, algas.	solo referencia
71	The Tarpon in the Panama Canal.	Hildebrand, Samuel F.	1937	Peces	Reporte en el Canal	The Scientific Monthly, March, Vol. XLIV	Sabalo real, lago de Miraflores, Zona del Canal.	solo referencia
72	The Marine Fishes of Panama.	Meek, S.F.	1923	Peces	Taxonomía de peces marinos.	Field Museum of Natural History. Zoological Series. Publication No.215 Vol.XV	Canal de Panamá, Ictiología, Distribución.	solo referencia
73	Interoceanic Colonization of a Marine Goby Through the Panama Canal.	Rubinoff, Roberta et al	1968	Peces	Colonización de un gobido marino a través del Canal de Panamá.	Nature, Vol. 217, No.5127	Marine Goby, Panama Canal, Miraflores locks, Gatun lake.	Buena
74	Background for a New, Sea Level Panama Canal	Challinor. David	1972	Ambiental	Antecedentes para un nuevo canal a Nivel	Bulletin of the Biological Society of Washington, No.2, 1972.	Panama Canal, History.	solo referencia

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75	Observations on the Ecology of the Caribbean and Pacific Coast of Panama.	Glynn, Peter W.	1972	Ecology	Caribbean and Pacific Coast	Bulletin of the Biological Society of Washington, No.2, 1972.	Littoral environments, Transisthmian communities, mangrove shores.	Buena
76	Physical Characteristics of the Proposed Sea Level Isthmian Canal	Sheffey, John	1972	Ambiental	Aspectos físicos con la propuesta de un Canal a Nivel.	Bulletin of the Biological Society of Washington, No.2, 1972.	rutas, patrones de la marea, mar Caribe, océano Pacífico.	Buena
77	Exchange of Water Through the Proposed Sea-level Canal At Panama.	Harleman, Donald	1972	Ambiental	magnitudes y direcciones de las mareas.	Bulletin of the Biological Society of Washington, No.2, 1972.	Mareas, corrientes, modelos matemáticos.	Buena
78	A Review of the Marine Plants of Panama	Earle, Sylvia A.	1972	Plantas Marinas	Taxonomía y biodiversidad	Bulletin of the Biological Society of Washington, No.2, 1972.	Plantas marinas, taxonomía, ecología.	Buena
79	Ecology and Species Diversity of Coral Reefs on Opposite Sides of the Isthmus of Panamá.	Porter, James W.	1972	Ecología y Diversidad	Arrecifes coralinos	Bulletin of the Biological Society of Washington, No.2, 1972.	Ecología, Arrecifes, diversidad de especies, istmo de Panamá.	Buena
80	Origin of the Existing Panamic Molluscan Biotas in Terms of their Geologic History and their Separation	Olsson, Axel A.	1972	Paleoecology and Geologic History	Origin of the Existing panamic molluscan biotas.	Bulletin of the Biological Society of Washington, No.2, 1972.	Panamic molluscan, geologic history, isthmian land barrier.	Buena
81	Comparative Habitat Diversity and Faunal Relationships Between the Pacific and Caribbean Panamanian Decapod Crustacea: A Preliminary Report, with some remarks on the Crustaceans Fauna of Panama.	Abele, Lawrence	1972	Ecology and Habitat diversity	Pacific and Caribbean panamanian decapod crustacean.	Bulletin of the Biological Society of Washington, No.2, 1972.	Habitat diversity, Decapod crustacea, mangrove fauna, Pacific and Caribbean habitats.	Buena
82	The Status of Knowledge of Panamanian Echinods, 1971, with Comments on other Echinoderms.	Chesher, Richard H.	1972	Taxonomía y Ecología	Echinoderms de Panamá.	Bulletin of the Biological Society of Washington, No.2, 1972.	Echinoderms, taxonomía, ecología,	Buena
83	The State of Knowledge of the Coastal Fish Fauna of the Panamic region Prior to the Construction of an Interoceanic Sea-Level Canal.	Robins, C. Richard	1972	Peces	diversidad de especies	Bulletin of the Biological Society of Washington, No.2, 1972.	Peces costeros, estuarios, peces continentales, mar Caribe.	Buena
84	The Marine Fisheries of Panama.	Bullis, Harvey R. & Klima, E.F.	1972	Peces	Pesqueria y peces marinos	Bulletin of the Biological Society of Washington, No.2, 1972.	Pesquería, peces marinos, Panamá, Tuna, pesquería incidental.	solo referencia
85	Species Introduction in a Tropical Lake.	Zaret, Thomas M.& Paine, R.T.	1973	Ecology	Nuevas especies en un ecosistema.	Science, Vol. 182	Lagos tropicales, especies introducidas, pez sargento, niveles troficos.	Buena

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86	Los Principales Peces de los Lagos y Embalses Panameños.	Gonzalez, Rigoberto	2000	Peces	Ecología y taxonomía	Gonzalez, Rigoberto. 2000. Los Principales Peces de los Lagos y Embalses Panameños.	Aguas continentales, peces de agua dulce,	solo referencia
87	A collection of Brachyuran Crustacea from the Bay of Panama and the Fresh Water of the Canal Zone.	Boone, Lee	1929	Taxonomía y distribución	crustaceos marinos y dulceacuícolas.	The American Museum of Natural History Vol. LVIII Art. XL, pp 561-583	New records, rare species, fresh water, marine species	solo referencia
88	The Fishes of Barro Colorado, Gatun Lake, Panama.	Breder Jr., C.M.	1933	Taxonomía	Peces de Agua Dulce .	Zoologica, Scientific Contributions of the New York Zoological Society, Volume IX. Number 16.	Freshwater fishes, Barro Colorado island, Gatun Lake.	Buena
89	Anomuran Macruran Crustacea from Panama and Canal Zone.	Boone, Lee	1931	Taxonomía	Crustaceos marinos y dulceacuícolas.	Bulletin of the American Museum of Natural History, Vol. LXIII 1931. Article II	Decapod crustacea, Canal Zone, Anomura, Macrura.	solo referencia
90	Ictiofauna del Lago Alajuela y sus Afluentes.	Briceño, Jorge	1981	Inventario Biológico	Peces	ConCiencia 8(2):15-19. 1981	Lago Alajuela, Pez Sargento, inventario de peces.	Buena
91	The Decapod Crustaceans of The Panama Canal.	Abele, Lawrence & Won Kim	1989	Taxonomía y distribución	Crustaceos decapodos.	Smithsonian Contributions to Zoology, Number 482. 1989.	Biota del Canal de Panama, crustaceos decapodos, taxonomía.	Buena
92	El Manglar Recurso Económico	Mirna Hidalgo & Dagmar Henriquez	N/A					
93	Superfamilia Viviparacea	Apple snails org.	2004	Taxonomía y distribución	Moluscos	Apples Snail web Page: http://members.tripod.com/arnobrosi/apple.html	Pomacea, distribución, especies	solo referencia
94	Sal Water Intrusion Analysis, Panama Canal Locks	Delft Hydraulics	2004	Salinity Intrusion	Panama Canal Locks	Task Report For Evaluation of salt water intrusion mitigacion system for revised 3-lift lock configurations.	Salt water intrusion, panama canal locks, Gatun and Miraflores locks,	Buena
95	Marine Fishes of Panama as Related to the Canal	Gunter, Gordon	1974	zoogeography	Marine Fishes		zoogeography, canal of Panama.	Buena
96	Salinity Intrusion in the Panama Canal.	Parchure, T.M. et al	2000	Salinity	Canal of Panama	U.S. Army Corps of Engineers	Salt Loading, salinity intrusion, Navigation locks, Panama Canal.	Buena

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97	Canal Zone Water Quality Study.	Gonzalez F., Alfredo	1975	Water Quality	Canal of Panama	Final Report. Vol 1-3. Water and Laboratory Branch, Panama Canal Company	Water quality, Gatun lake, atlantic and pacific marine regions, waste areas.	Buena
98	Limnological Features of a Tropical Meromictic Lake.	Bosniak, E. G. et al	1969	Limnological study in a Tropical Lake.	Miraflores Lake third locks	Hidrobiology, 1969. V. 34, p. 524-532.	Temperature, Transparency, chemical conditions, biological conditones, Miraflores lake.	Buena
99	Municipal Engineering and Domestic Water Supply in the Canal Zone.	Wells, George M.	1916	Engineering and domestic water supply	Canal Zone	Panama Canal Comision, Technical Resources Center	Water supply, Municipal engineering, Canal Zone.	Buena
100	Manejo de Sistemas de Agua Potable y Saneamiento Ambiental.	Barajas, Oscar M.	1995	Agua potable y sistemas	Manejo de sistemas de Agua Potable y Saneamiento Ambiental.	Oscar Barajas Webpage: www.Oscarbarajas.com/3cap.html	Agua potable, plantas portátiles	solo referencia
101	Secondary Drinking Water Regulations: Guidance for nuisance Chemicals	U.S. Environmental Protection Agency.	1992	Drinking waters standards	Water Standards	http://www.epa.gov/safewater/consumer/2ndstandards.html	Secondary standards, drinking water, epa	solo referencia
102	Biologically-Based Estuarine Salinity Zones Derived from a Multivariate Analysis	Bulger, A.J. et al	2002	Multivariate Analysis.	Analysis on biologically based Salinity zones in Estuaries.	Estuaries 16:2 pp. 311-322	Multivariate analysis, estuaries, salinity Zones	solo referencia
103	What is the Ecological Condition of Fresh Waters.	U.S. Environmental Protection Agency.	2003	Ecological conditions of Fresh water	Ecological conditions	Technical Document, EPA'S Draft Report on the Environment 2003.	Fresh water, reservoirs, streams, rivers	solo referencia
104	Practical Handbook of Marine Science. Third edition.	Kennish, Michael, J.	2001	Marine Sciences	ecology	Practical Handbook of Marine Science. Third edition.	Salinity, surface enrichment	solo referencia
105	Marine Technology, Reference Book.	Morgan, Nina. Editor	1990	Marine and Offshore Technology.	Marine Technology	Marine Technology, Reference Book. Edited by Nina Morgan.	Marine technology, oceans environments.	solo referencia
106	Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers. Periphyton, Benthic Macroinvertebrates, and Fish.	EPA	1999	Rapid Bioassessment	Periphyton, Benthic macroinvertebrates nad fish in Streams and rivers.	EPA 841-B-99-002	Periphyton, macroinvertebrates, fish, Rapid bioassessment, streams, rivers.	Buena

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107	Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance.	EPA	2000	Estuarine and coastal Marine waters.	Biocriteria Technical Guidance	EPA 822-B-00-024	Biocriteria, Technical guidance, estuaries, and marine waters.	solo referencia
108	Historic Separation or Recent Introductions: The Phylogeography of Phyllidictyon anastomosans, with emphasis on amphi.Isthmian Populations from Central America.	Brian Wyssor	2001	Phylogeography	Algae Phyllidictyon anastomosans	Department of Biology of The University of Louisiana at Lafayette	Panama Canal, Phyllidictyon, Interceanic dispersal..	solo referencia
109	Ecological Aspects of the Freshwater Decapod Crustaceans of the Perlas Archipelago, Panama.	Abele, Lawrence G.	1977	Crustaceans	Ecology	Biotropica 9 (4): 239-252 1977	Decapod crustaceans, Perlas Archipelago, freshwaters streams	solo referencia
110	Zooplankton Associations in East African Lakes Spanning a wide salinity range.	Green, J.	1993	Zooplankton	Salinity range and diversity of species	Hydrobiología 267: 249-256	Rotifera, Copopoda, cladocera, species richness, salinity.	Buena
111	Water Quality Management in Pond Fish Culture.	Boyd, Claude E. & Lichtkoppler, F.	1979	Pond Fish Culture	Water Quality Management	Research and Development Series No. 22. Project AID/DSAN-G 0039	Water quality, pond fish culture, chemical and physical factors.	Buena
112	Guía de las Aves de Panamá, Incluyendo Costa Rica, Nicaragua y Honduras	Ridgely, R.S. & Gwynne, J. A.	1993	Aves	Taxonomía de aves, distribución, ecología	Guía de las Aves de Panamá, Incluyendo Costa Rica, Nicaragua y Honduras	Aves, area el canal, especies acuáticas.	Buena