Appendix S1. Variable selection.

A combination of categorical and continuous variables was used to assign attributes for each species (Table 1). Rationale for selection of variables is detailed as follows.

Family

This variable was included to account for effects of phylogenetic relationships among species (Kolar & Lodge 2002, Alcaraz et al. 2005, Ruesink 2005, Bomford et al. 2009, 2010). Family-level taxonomy followed van der Laan et al. (2014).

History

This variable is a measure of prior invasion success, defined as the total number of tropical islands or island groups throughout the world, excluding the Hawaiian Islands and Guam, where a species was introduced and became established. Prior invasion success has been positively correlated with the probability that a species will become established when introduced into a new area (Daehler & Strong 1993, Kolar & Lodge 2002, Marchetti et al. 2004a, b, Hayes & Barry 2008, Bomford et al. 2009, 2010). Data pertaining to the establishment of different fish species were based on published literature (Maciolek 1984, Welcomme 1988, Eldredge 1994, Lever 1996, Eldredge 2000), accounts in FishBase (Froese & Pauly 2000, 2021), online records (USGS 2021), consultation with subject-matter experts, and field surveys by the authors.

Pathway/human use

Principal pathways for introductions of freshwater fishes include aquaculture, stocking of game, live food industry, release of aquarium species, biocontrol of insects such as mosquitos, other fish species, or vegetation, release of bait fish, ship ballast water, and water diversions (Welcomme 1988, Courtenay & Stauffer 1990, Nelson & Eldredge 1991, LoVullo & Stauffer 1993, Fuller et al. 1999, Ricciardi & MacIsaac 2000, Yamamoto & Tagawa 2000, Rahel 2002, Fuller 2003, De Silva et al. 2004, Padilla & Williams 2004, Kerr et al. 2005, Rixon et al. 2005, Lapointe et al. 2016). In our analysis 12 different pathway categories were distinguished. The number and combinations of different pathways that each species is known to have been introduced in the Pacific region, other islands of the world, or in non-insular regions was based on literature (Brock 1960, Welcomme 1981, Maciolek 1984, Welcomme 1988, 1992, Eldredge 1994, 2000) and personal knowledge of the authors. Each pathway category was assigned a score of 1 for documented and 0 for undocumented. For each species pathway scores were tallied, and the sum treated as a continuous variable. We predicted that species with a higher pathway score would have a higher probability of establishment based on an *a priori* assumption that such species were more likely to have been introduced on multiple occasions or in large numbers over an extended time, possibly by multiple pathways, and thus directly or indirectly representing a component of high propagule pressure (Kolar & Lodge 2001, Lockwood et al. 2005, Ruesink 2005, Colautti et al. 2006, Duggan et al. 2006, Gertzen et al. 2008).

Body size (maximum adult length)

This variable is a measure of the approximate maximum length that adult individuals achieve under favorable growth and survival conditions in the wild (Marchetti et al. 2004a). Four different categories were used because precise quantitative information on the size of fish in the wild is often poorly documented, size reported may have been of fish reared in captivity, and method of measurement varies and is sometimes unspecified (i.e., total, standard, or fork length). Information on maximum body length was obtained primarily from Fuller et al. (1999), FishBase (Froese & Pauly 2000, 2021), and Page & Burr (2011).

It has been suggested that species with a higher intrinsic rate of increase, *r*, are more likely to become established (Crawley 1986). Further, large-bodied fish species may have a relatively low probability of establishment success based on the ***r***–K continuum (Ruesink 2005). However, the effect of body size on establishment success might also depend on the type of competition faced by an introduced species (Crawley 1986). Additionally, species held as pets that attain a large size may be more likely to be released by owners once the animals outgrow their aquaria (Gertzen et al. 2008). Maximum length was not included in the best model of establishment success reported by Kolar & Lodge (2001) or by Marchetti et al. (2004b). However, maximum length was included in the best model of establishment success reported by Marchetti et al. (2004a), although slopes for maximum length were not reported in that study. We originally scored an additional categorical variable for longevity but omitted it from our model for three reasons: (1) lifespans reported in the literature are variable and in some cases conflated by data from specimens reared in captivity; (2) lifespan information was unavailable for many species, and; (3) lifespan and maximum adult length were assumed to be correlated.

Adult trophic category

Based on an analysis of terrestrial animals (mainly insects) in Europe, Crawley (1986) stated that herbivores were more likely to become established than carnivores or detritivores because herbivores experience less competition as a result of the resource being less limiting. In assessing fish invasions in California, Moyle & Light (1996a, b) suggested that trophic status is an important predictor of establishment success, but they argued that piscivores and detritivores/omnivores appeared to have greater establishment success (and planktivores in lentic systems), with the caveat that such an outcome was most likely in aquatic habitats with relatively low levels of human disturbance. Ruesink (2005) found that establishment success was higher for omnivorous fishes, which is consistent with the hypothesis that generalists are particularly well suited to invading new areas (Blackburn et al. 2009). However, Moyle & Marchetti (2006) found no evidence of such a relationship. Kolar & Lodge (2002) created a complex index of diet by combining diet breadth and foraging habitat, and found the resulting index to be correlated with establishment success.

Our analysis included seven categories of adult trophic status that generally increased from the lowest consumer level (detritivore/algivore; category 1) to highest consumer level (piscivore/top predator; category 7). The classification was based on qualitative and quantitative information available in Goldstein & Simon (1999), FishBase (Froese & Pauly 2000, 2021), and the authors' personal knowledge. For species with little or nothing published, categorization was based on information available for closely related or similar species. A continuous trophic variable based on a quantitative index from FishBase that combines diet composition with the trophic level of food items consumed was originally considered for inclusion. However, we subsequently determined that this continuous trophic index was positively correlated with our categorical classification. Use of our categorical data set conferred the ability to estimate separate slopes for each diet category.

Reproductive guild

Measures of parental care, fecundity, and egg size were included as variables by Kolar & Lodge (2002) and Marchetti et al. (2004a, b) in their analyses of the establishment, spread, and impacts of non-native fishes. We considered these variables to be interrelated and combined them into a single categorical variable with three levels based in part on Goldstein & Simon (1999) and on personal knowledge. Ruesink (2005) suggested that species with high fecundity may have higher establishment success. However, Moyle & Marchetti (2006) concluded that species with intermediate or mixed life-history characteristics involving fecundity as well as lifespan and parental care were likely to be the most successful invaders, although fish with nearly any life-history strategy can successfully invade. Our *a priori* prediction was that species with an intermediate score for this variable would have greatest establishment success.

Spawning habitat

We sought to include at least one ecological variable related to habitat and posited that the general type of spawning habitat is an important factor for establishment success. In the absence of suitable spawning habitat, introduced individuals might survive and grow but would ultimately fail to reproduce and persist as a self-sustaining population. We developed a categorical covariate with five levels representing the general hydrologic characteristics of spawning habitat, considering that flow regime has been demonstrated to affect population persistence of non-native fishes (Marchetti & Moyle 2001).

Climate profile

This variable indicates the types and number of different climate regions represented in the native geographic range of a species. We recognized five categories that provided information on the type of climate based on the latitudinal distribution of a species. Our categories were: (1) temperate, native range within 30-50° N or S; (2) subtropical, ranging between temperate and tropical; (3) tropical, native range between the Tropic of Cancer and Tropic of Capricorn (23° N and S, respectively); and combinations of (4) temperate/subtropical and (5) subtropical/tropical. Because of singularity, the number of climate parameters was reduced to three in our model: species initially scored as temperate/subtropical were re-scored as temperate, and species initially scored as subtropical/tropical were re-scored as tropical. Assignment of the different fish species to particular categories was based on information provided in the scientific literature, FishBase (Froese & Pauly 2000, 2021), and our own knowledge. Climate profiles have been used in various species distribution models including climate matching, intended to predict the potential range of dispersal of an introduced species based on similarity to the climate found in its native range (Peterson 2003, Franklin 2009, Bomford et al. 2010, Howeth et al. 2016).

The presence, absence, or relative abundance of a species in a climatic region is affected by its tolerance or preference for an ambient temperature range. A general assumption is that climate is correlated with a given range of temperatures and therefore approximates a species' relative temperature tolerance. Species with broad thermal tolerances are generally considered to have a greater probability of establishment success (Kolar & Lodge 2002, Moyle & Marchetti 2006, Blackburn et al. 2009). Rather than attempt to estimate the range of temperatures suitable for survival and reproduction based on limited or nonexistent data for many species, we used a categorical classification of climate in a species' native range as a surrogate (i.e., distribution in temperate, subtropical, or tropical regions and combinations thereof). This represents a qualitative form of climate matching used in some studies of establishment success (Bomford et al. 2009, 2010, Fujisaki et al. 2009). We predicted that tropical and subtropical species were most likely to establish successfully in Hawaii and Guam.

Salinity tolerance

As with temperature, a wide zone of salinity tolerance may increase probability of establishment success (Kolar & Lodge 2002, Moyle & Marchetti 2006, Blackburn et al. 2009). We used a categorical variable with three levels and predicted *a priori* that species tolerant to a wide range of salinities (euryhaline) would have greatest establishment success. As with other parameters, the classification scheme and assignment of the different fish species to particular categories was based on the scientific literature, FishBase (Froese & Pauly 2000, 2021), personal knowledge, or inference from what is known about similar species. Species identified as intolerant to salinity (stenohaline) were expected to have lowest establishment success.

Hypoxia tolerance

The ability of a species to inhabit water with low dissolved oxygen levels involves hypoxia tolerance (Bickler & Buck 2007, Mandic et al. 2009, Rogers et al. 2016). As with temperature and salinity, hypoxia tolerance was recognized as a categorical variable with three qualitative levels. Species with low to intermediate tolerance of low dissolved oxygen were scored as (1) intolerant (e.g., salmonids) versus (2) moderately tolerant (e.g., poeciliids, fundulids, cichlids). Species that are (3) very tolerant of low dissolved oxygen levels (i.e., air breathers) were predicted *a priori* to have the greatest establishment success. We also posited that species moderately tolerant of low dissolved oxygen and that are capable of aquatic surface respiration (Kramer & McClure 1982) would have intermediate- to high-establishment success.

As an alternative to using three independent physiological variables, climate profile (proxy of temperature tolerance), salinity tolerance, and hypoxia tolerance were combined to form a composite score for a single variable termed "environmental tolerance." Hypothetically, for example, a temperate freshwater species intolerant of salinity or low dissolved oxygen levels would receive an environmental tolerance score of 3 (1 + 1 + 1), whereas a subtropical/tropical, air-breathing species tolerant of high salinities would receive a score of 11 (5 + 3 + 3). This variable was treated as continuous to reduce the number of parameters in the most general model and to facilitate model convergence.

Appendix S2. Results of model fitting procedure.

The error rate for the best model was estimated as the proportion of observations in the data set for which the fitted value > 0.5 and species status in the study area = 0 or fitted value < 0.5 and status = 1. This occurred for seven of 80 species equating to an error rate of 0.088 (Fig. S1). This represented a 77% reduction in the error rate of the null model, 0.388.

The R code uses the 'sim' function from the 'arm' package (Gelman & Hill 2006: 158–162, Gelman et al. 2020). The code creates 1000 sets of parameter estimates for the most general model. For each of those 1000 sets of simulated parameter estimates the code simulates which species become established (1) and which do not (0). Thus, the code creates 1000 different versions of our status variable. For each simulated version of the status variable the code determines whether there are more 0's than are present in the real status variable. In other words, the code essentially determines whether more simulated species failed to establish than real species. Of 1000 simulated data sets created using the most general model, 57.5% contained more species that failed to establish than the 38.8% present in the actual data (Fig. S2). In Fig. S2 there are 1000 dots, each corresponding to the proportion of zeros (species that did not establish) in the simulated data set. There is also a horizontal black line corresponding to the proportion of species that did not establish in the real data set. The p-value for model fit is the number of dots above the horizontal black line divided by 1000 (because there were 1000 simulated data sets), i.e., in 57.5% of the simulated data sets there were more species that failed to establish than in the real data set. The horizontal black line in the plot is close to the center of the cloud of dots, indicating good model fit. If the horizontal black line was near the bottom of the plot that would mean there were far more species that failed to establish in the simulated data than in the real data, which would indicate the model did not fit the real data. Similarly, if the horizontal black line was near the top of the plot that would indicate there were far fewer simulated species that failed to establish than in the real data, which also would indicate a lack of model fit. These results did not indicate a problem with model fit of either the most general model or the best model.

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Table S1. Status of nonindigenous freshwater fishes known to have been introduced into Hawaii and Guam since the late 1800s. Status: 0 = introduced, not known to be established; 1 = established, defined as a self-sustaining, wild population. Species of questionable identity indicated by use of "cf.," "?," "sp.," or "complex." Shading indicates air-breathing species. Fitted values for best model (#23) of establishment success in risk analysis (see text).

Family	Scientific name	Common name	Hawaii status	Guam status	Fitted value
Adrianichthyidae	*Oryzias latipes*	Japanese Medaka	0	---	0.060
Anguillidae	*Anguilla japonica*	Japanese Eel	---	0	0.031
Anguillidae	*Anguilla marmorata*	Giant Mottled Eel	0	---	0.031
Anguillidae	*Anguilla rostrata*	American Eel	---	0	0.031
Anostomidae	*Leporinus fasciatus*	Banded Leporinus	0	---	0.183
Aplocheilidae	*Aplocheilus lineatus*	Striped Panchax	0	---	0.043
Ariidae	*Arius* sp.	Sea Catfish	---	0	0.183
Belonidae	*Xenentodon cancila*	Asian Needlefish	1	---	0.557
Blenniidae	*Omobranchus ferox*	Fang-toothed Blenny	1	---	0.780
Callichthyidae	*Corydoras aeneus*?	Green Corydoras	1	---	0.930
Centrarchidae	*Lepomis cyanellus*	Green Sunfish	1	---	0.711
Centrarchidae	*Lepomis macrochirus*	Bluegill	1	---	0.939
Centrarchidae	*Micropterus dolomieu*	Smallmouth Bass	1	0	0.953
Centrarchidae	*Micropterus salmoides*	Largemouth Bass	1	0	0.990
Centropomidae	*Lates calcarifer*	Barramundi	---	0	0.060
Channidae[a]	*Channa striata*	Chevron Snakehead	---	1	---
Channidae[a]	*Channa maculata*	Blotched Snakehead	1	0	0.995
Characidae	*Colossoma macropomum*?	Tambaquí	0	---	0.037
Characidae	*Pygocentrus nattereri*	Red Piranha	0	---	0.165
Cichlidae	*Amatitlania nigrofasciata*	Convict Cichlid	1	---	0.929
Cichlidae	*Amphilophus citrinellus*	Midas Cichlid	1	---	0.768
Cichlidae	*Amphilophus labiatus*	Red Devil	0	---	0.840
Cichlidae	*Astronotus ocellatus*	Oscar	1	1	0.840
Cichlidae	*Cichla ocellaris*?	Peacock Cichlid	1	1	0.954
Cichlidae	*Cryptoheros spilurus*	Blue-eyed Cichlid	1	---	0.768
Cichlidae	*Hemichromis elongatus*	Banded Jewelfish	1	---	0.768
Cichlidae	*Hypsophrys nicaraguensis*	Nicaragua Cichlid	1	---	0.768
Cichlidae	*Melanochromis johanni*	Bluegray Mbuna	1	---	0.768
Cichlidae	*Oreochromis macrochir*	Longfin Tilapia	1	---	0.929

Cichlidae	*Oreochromis mossambicus*	Mozambique Tilapia	1	1	1.000
Cichlidae	*Parachromis managuense*	Jaguar Guapote	1	---	0.954
Cichlidae	*Pelvicachromis pulcher*	Rainbow Krib	1	---	0.768
Cichlidae	*Pterophyllum* sp.	Freshwater Angelfish	0	---	0.768
Cichlidae	*Sarotherodon melanotheron*	Blackchin Tilapia	1	---	0.768
Cichlidae	*Thorichthys meeki*	Firemouth Cichlid	1	---	0.840
Cichlidae	*Tilapia rendalli*	Redbreast Tilapia	1	---	0.992
Cichlidae	*Tilapia zillii*	Redbelly Tilapia	1	1	0.988
Clariidae	*Clarias batrachus*	Walking Catfish	---	1	0.986
Clariidae	*Clarias fuscus*	Whitespotted Clarias	1	---	0.948
Clariidae	*Clarias macrocephalus*	Bighead Catfish	---	1	0.948
Clupeidae	*Dorosoma petenense*	Threadfin Shad	1	---	0.815
Cobitidae	*Misgurnus anguillicaudatus*	Oriental Weatherfish	1	---	0.964
Cyprinidae	*Carassius auratus*	Goldfish	1	---	0.959
Cyprinidae	*Ctenopharyngodon idella*	Grass Carp	0	0	0.130
Cyprinidae	*Cyprinus carpio*	Common Carp	1	1	0.959
Cyprinidae	*Hypophthalmichthys nobilis*	Bighead Carp	---	0	0.130
Cyprinidae	*Puntius filamentosus*	Blackspot Barb	1	---	0.550
Cyprinidae	*Puntius lateristriga*	Spanner Barb	---	0	0.550
Cyprinidae	*Puntius semifasciolatus*	Green Barb	1	---	0.659
Fundulidae	*Fundulus grandis*	Gulf Killifish	0	---	0.043
Gobiidae	*Mugilogobius cavifrons*	Mangrove Goby	1	---	0.780
Ictaluridae	*Ameiurus nebulosus*	Brown Bullhead	0	---	0.123
Ictaluridae	*Ictalurus punctatus*	Channel Catfish	1	0	0.821
Kuhlidae	*Kuhlia rupestris*	Rock Flagtail	0	---	0.183
Loricariidae	*Ancistrus* cf. *temmincki*	Suckermouth Catfish	1	---	0.928
Loricariidae	*Hypostomus* cf. *watwata*	Suckermouth Catfish	1	---	0.928
Loricariidae	*Peckoltia* sp.	Peckoltia	0	---	0.086
Loricariidae	*Pterygoplichthys* sp.	Sailfin Catfish	1	---	0.995
Lutjanidae	*Lutjanus fulvus*	Blacktail Snapper	1	---	0.780
Mochokidae	*Synodontis* sp.	Squeaker Catfish	0	---	0.043
Moronidae	*Morone saxatilis*	Striped Bass	0	---	0.183
Nothobranchiidae	*Nothobranchius guentheri*	Redtail Notho	0	---	0.043

Osphronemidae	*Betta pugnax*	Penang Betta	---	1	0.245
Osphronemidae	*Osphronemus goramy*	Giant Gourami	0	---	0.890
Osphronemidae	*Trichogaster leerii*	Pearl Gourami	0	---	0.339
Osteoglossidae	*Osteoglossum bicirrhosum*?	Arawana	0	---	0.043
Pangasiidae	*Pangasianodon hypophthalmus*	Iridescent Shark-Catfish	---	0	0.465
Plecoglossidae	*Plecoglossus altivelis*	Ayu	0	---	0.183
Poeciliidae	*Gambusia* sp.	Mosquitofish	1	1	1.000
Poeciliidae	*Limia vittata*	Cuban Limia	1	---	0.390
Poeciliidae	*Poecilia latipinna*	Sailfin Molly	1	1	0.864
Poeciliidae	*Poecilia mexicana/sphenops complex*	Shortfin Molly	1	---	0.910
Poeciliidae	*Poecilia reticulata*	Guppy	1	1	1.000
Poeciliidae	*Xiphophorus hellerii*	Green Swordtail	1	1	0.998
Poeciliidae	*Xiphophorus maculatus*	Southern Platyfish	1	0	0.990
Poeciliidae	*Xiphophorus variatus*	Variable Platyfish	0	---	0.503
Salmonidae	*Oncorhynchus mykiss*	Rainbow Trout	1	---	0.630
Salmonidae	*Oncorhynchus tshawytscha*	Chinook Salmon	0	---	0.146
Salmonidae	*Salmo trutta*	Brown Trout	0	---	0.300
Salmonidae	*Salvelinus fontinalis*	Brook Trout	0	---	0.146
Synbranchidae	*Monopterus albus*?	Swamp Eel	1	---	0.930

[a] Only one *Channa* was used in the modeling analysis due to taxonomic ambiguity, unverified identifications, and similar functional guild.

Table S2. List of tropical and subtropical islands, island groups, and/or country names, excluding Hawaii and Guam, reviewed for records of non-native inland fish species introductions.

Island, island group, and/or country	Ocean
Agaléga Islands	Indian
Andaman and Nicobar Islands	Indian (Bay of Bengal)
Anguilla	Atlantic (Caribbean Sea)
Antigua and Barbuda	Atlantic (Caribbean Sea)
Bahamas	Atlantic
Barbados	Atlantic (Caribbean Sea)
Bermuda	Atlantic
Bougainville Island	Pacific
British Virgin Islands	Atlantic (Caribbean Sea)
Brunei (Island of Borneo)	Pacific
Cape Verde	Atlantic
Cargados Carajos (Saint Brandon)	Indian
Cayman Islands	Atlantic (Caribbean Sea)
Chagos Archipelago	Indian
Christmas Island	Indian
Clipperton Island	Pacific
Coco Islands (of Myanmar)	Indian (Bay of Bengal)
Cocos (Keeling) Islands	Indian
Cocos Island (of Costa Rica)	Pacific
Comoro Islands	Indian
Cook Islands	Pacific
Coral Sea Islands	Pacific (Coral Sea)
Cuba	Atlantic (Caribbean Sea)
D'Entrecasteaux Islands	Pacific (Solomon Sea)
Dominica	Atlantic (Caribbean Sea)
Dominican Republic (Island of Hispaniola)	Atlantic (Caribbean Sea)
Easter Island	Pacific
Federated States of Micronesia (Yap, Chuuk, Pohnpei, Kosrae)	Pacific
Fiji	Pacific
French Polynesia: Austral Islands	Pacific
French Polynesia: Gambier Islands	Pacific
French Polynesia: Marquesas Islands	Pacific
French Polynesia: Society Islands	Pacific
Galápagos Islands	Pacific
Glorioso Islands (Îles Glorieuses)	Indian
Great Barrier Reef	Pacific (Coral Sea)
Grenada	Atlantic (Caribbean Sea)
Guadeloupe and Martinique	Atlantic (Caribbean Sea)
Haiti (Island of Hispaniola)	Atlantic (Caribbean Sea)
Indonesia (in part: Bali, Java, Lombok, Sumatra, Lesser Sundas; West and East Timor)	Indo-Pacific
Indonesia (in part: Kalimantan on Borneo, western half of Island of New Guinea [=Irian Jaya], Bangka, Sulawesi [=Celebes], Molucca Islands)	Indo-Pacific
Jamaica	Atlantic (Caribbean Sea)
Johnston Atoll (USA)	Pacific
Kanton (Canton) and Enderbury Islands	Pacific
Kiribati (includes Gilbert Islands, Phoenix Islands, and part of Line Islands)	Pacific
Lakshadweep (includes Laccadive Islands, Aminidivi Islands)	Indian (Arabian Sea)
Lesser Antilles	Atlantic (Caribbean Sea)
Louisiade Archipelago	Pacific (Coral-Solomon Seas)

Madagascar	Indian
Malaysia	Pacific
Maldives	Indian (Arabian Sea)
Marshall Islands	Pacific
Martinique	Atlantic (Caribbean Sea)
Mauritius	Indian
Montserrat	Atlantic (Caribbean Sea)
Nauru	Pacific
Navassa Island	Atlantic (Caribbean Sea)
Netherlands Antilles	Atlantic (Caribbean Sea)
New Caledonia	Pacific (Coral Sea)
Niue	Pacific
Northern Mariana Islands (Saipan, Pagan, Tinian)	Pacific
Palau	Pacific
Papua New Guinea	Pacific
Philippines	Pacific
Pitcairn Islands	Pacific
Puerto Rico	Atlantic (Caribbean Sea)
Réunion	Indian
Rodrigues	Indian
Saint Kitts and Nevis	Atlantic (Caribbean Sea)
Saint Lucia	Atlantic (Caribbean Sea)
Saint Vincent	Atlantic (Caribbean Sea)
Samoa Islands (Independent State of Samoa and American Samoa)	Pacific
São Tomé and Príncipe	Atlantic
Seychelles	Indian (Somali Sea)
Singapore	Pacific
Socotra	Indian
Solomon Islands	Pacific
Sri Lanka	Indian
Tokelau	Pacific
Tonga	Pacific
Trinidad and Tobago	Atlantic (Caribbean Sea)
Trobriand Islands (Kiriwina Islands)	Pacific (Solomon Sea)
Tromelin Island	Indian
Tuamotu Archipelago	Pacific
Tubuai	Pacific
Turks and Caicos Islands	Atlantic
Tuvalu	Pacific
U.S. Virgin Islands	Atlantic (Caribbean Sea)
Vanuatu (New Hebrides)	Pacific
Venezuela Coastal Islands	Atlantic (Caribbean Sea)
Wake Island	Pacific
Wallis and Futuna	Pacific

Table S3. Data matrix used in frequentist models for risk assessment of establishment success for non-native inland fishes of Hawaii and Guam. HS, status in Hawaii; GS, status in Guam (0 = introduced, not established; 1 = established). Variable codes correspond to Table 1; sum = total number of pathways (variable 3).

Dependent Variable		Taxon	Independent Variable																					
HS	GS		1	2	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	Sum	4	5	6	7	8	9	10	11
0		*Osteoglossum bicirrhosum* ?	Osteoglossidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	3	7	3	4	3	1	2	6
	0	*Anguilla japonica*	Anguillidae	0	1	0	0	0	0	0	0	0	1	0	1	0	3	4	6	1	3	5	3	2	10
0		*Anguilla marmorata*	Anguillidae	0	1	0	0	0	0	0	0	0	1	0	1	0	3	4	7	1	3	5	3	2	10
	0	*Anguilla rostrata*	Anguillidae	0	1	0	0	0	0	0	0	0	1	0	1	0	3	4	6	1	3	5	3	2	10
1		*Dorosoma petenense*	Clupeidae	1	1	0	0	0	0	0	1	1	0	0	0	0	3	2	3	1	5	4	2	1	7
1		*Carassius auratus*	Cyprinidae	12	1	1	1	1	0	0	1	1	1	0	0	0	7	3	4	1	2	1	2	2	5
0	0	*Ctenopharyngodon idella*	Cyprinidae	1	1	0	0	1	1	1	0	0	1	0	0	0	5	4	2	1	1	1	2	2	5
1	1	*Cyprinus carpio*	Cyprinidae	12	1	1	1	1	1	1	0	1	1	0	0	0	8	4	4	1	5	1	2	2	5
	0	*Hypophthalmichthys nobilis*	Cyprinidae	1	1	0	0	1	1	1	0	1	1	0	1	0	7	4	3	1	1	4	1	2	7
1		*Puntius filamentosus*	Cyprinidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	5	1	1	5	2	1	8
	0	*Puntius lateristriga*	Cyprinidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	4	1	1	5	1	1	7
1		*Puntius semifasciolatus*	Cyprinidae	1	1	1	0	0	0	0	0	0	0	0	0	0	2	1	4	1	1	2	1	1	4
1		*Misgurnus anguillicaudatus*	Cobitidae	2	1	1	0	0	1	0	0	1	1	0	0	0	5	2	4	1	4	4	1	3	8
0		*Leporinus fasciatus*	Anostomidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	4	2	1	3	1	1	5
0		*Colossoma macropomum* ?	Characidae	2	1	1	0	0	1	0	0	0	1	0	0	0	4	4	2	1	4	3	1	2	6
0		*Pygocentrus nattereri*	Characidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	3	7	2	4	3	1	1	5
0		*Ameiurus nebulosus*	Ictaluridae	1	1	0	0	0	1	1	0	0	0	0	0	0	3	3	4	2	4	4	2	2	8
1	0	*Ictalurus punctatus*	Ictaluridae	3	1	1	0	0	1	1	0	0	1	0	0	0	5	4	4	2	4	4	2	1	7
	0	*Pangasianodon hypophthalmus*	Pangasiidae	2	1	1	0	0	0	0	0	0	0	0	0	0	2	4	4	1	4	5	1	3	9
	1	*Clarias batrachus*	Clariidae	3	1	1	0	0	1	0	0	0	1	0	0	0	4	3	4	2	5	5	2	3	10
1		*Clarias fuscus*	Clariidae	0	1	1	0	0	1	0	0	0	1	0	0	0	4	2	6	2	2	5	1	3	9
	1	*Clarias macrocephalus*	Clariidae	0	1	1	0	0	0	1	0	0	1	0	0	0	4	4	6	2	5	5	2	3	10
	0	*Arius* sp.	Ariidae	0	0	1	0	0	0	0	0	1	0	0	0	0	2	3	6	3	3	5	3	1	9
0		*Synodontis* sp.	Mochokidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	1	4	3	1	2	6
1		*Corydoras aeneus* ?	Callichthyidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	1	4	1	4	3	1	3	7
1		*Ancistrus cf. temminckii*	Loricariidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	3	1	3	1	3	7

1		*Hypostomus cf. watwata*	Loricariidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	3	1	2	4	3	2	3	8
0		*Peckoltia* sp.	Loricariidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1	2	4	3	1	2	6
1		*Pterygoplichthys multiradiatus*	Loricariidae	6	1	1	1	0	0	0	0	0	0	0	0	0	3	3	1	2	4	3	1	3	7
0		*Plecoglossus altivelis*	Plecoglossidae	0	1	0	0	0	1	0	0	0	0	0	0	0	2	3	4	1	1	4	3	1	8
1		*Oncorhynchus mykiss*	Salmonidae	5	1	0	0	0	1	1	0	0	0	0	0	0	3	4	6	1	1	1	3	1	5
0		*Oncorhynchus tshawytscha*	Salmonidae	0	1	0	0	0	1	1	0	0	0	0	0	0	3	4	6	1	1	1	3	1	5
0		*Salmo trutta*	Salmonidae	2	1	0	0	0	0	1	0	0	0	0	0	0	2	4	6	1	1	1	3	1	5
0		*Salvelinus fontinalis*	Salmonidae	0	1	0	0	0	1	1	0	0	0	0	0	0	3	3	6	1	1	1	2	1	4
0		*Aplocheilus lineatus*	Aplocheilidae	0	0	1	0	1	0	0	0	0	0	0	0	0	2	1	5	1	5	2	2	2	6
0		*Nothobranchius guentheri*	Nothobranchiidae	0	0	1	0	1	0	0	0	0	0	0	0	0	2	1	5	1	5	3	1	2	6
0		*Fundulus grandis*	Fundulidae	0	0	1	0	1	0	0	0	1	0	0	0	0	3	2	4	1	3	2	3	2	7
1	1	*Gambusia affinis*	Poeciliidae	23	1	1	0	1	0	0	0	0	0	0	0	0	3	1	5	3	4	1	2	2	5
1		*Limia vittata*	Poeciliidae	0	0	1	0	1	0	0	0	0	0	0	0	0	2	1	4	3	4	2	2	2	6
1	1	*Poecilia latipinna*	Poeciliidae	5	0	1	0	1	0	0	0	0	0	0	0	0	2	2	4	3	5	2	3	2	7
1		*Poecilia mexicana/sphenops complex*	Poeciliidae	6	0	1	0	1	0	0	0	1	0	0	0	0	3	2	4	3	5	5	2	2	9
1	1	*Poecilia reticulata*	Poeciliidae	30	1	1	1	1	0	0	0	0	0	0	0	0	4	1	4	3	4	3	2	2	7
1	1	*Xiphophorus hellerii*	Poeciliidae	15	1	1	1	1	0	0	1	0	0	0	0	0	5	2	4	3	4	3	1	2	6
1	0	*Xiphophorus maculatus*	Poeciliidae	11	1	1	1	1	0	0	0	0	0	0	0	0	4	1	4	3	4	3	1	2	6
0		*Xiphophorus variatus*	Poeciliidae	1	1	1	1	1	0	0	0	0	0	0	0	0	4	1	4	3	4	3	1	2	6
0		*Oryzias latipes*	Adrianichthyidae	1	1	1	0	1	0	0	0	0	0	0	0	0	3	1	5	3	5	2	2	2	6
1		*Xenentodon cancila*	Belonidae	0	0	1	0	0	0	0	0	0	0	0	0	0	1	3	6	1	5	5	3	2	10
1		*Monopterus albus ?*	Synbranchidae	0	1	1	0	0	1	0	0	0	1	0	0	1	5	4	6	2	4	5	2	3	10
	0	*Lates calcarifer*	Centropomidae	1	1	0	0	0	0	0	0	0	1	0	0	0	2	4	6	1	3	5	3	2	10
0		*Morone saxatilis*	Moronidae	0	1	0	0	1	1	1	0	0	1	0	0	0	5	4	7	1	1	4	3	1	8
0		*Kuhlia rupestris*	Kuhlidae	0	1	0	0	0	1	1	0	0	0	0	0	0	3	3	4	1	3	5	3	1	9
1		*Lepomis cyanellus*	Centrarchidae	2	1	0	0	0	0	1	1	0	0	0	1	0	4	3	5	2	2	1	1	2	4
1		*Lepomis macrochirus*	Centrarchidae	6	1	0	0	0	0	1	1	0	0	0	0	0	3	3	5	2	2	4	1	2	7
1	0	*Micropterus dolomieu*	Centrarchidae	1	1	0	0	0	0	1	0	0	0	0	0	0	2	3	7	2	1	1	1	1	3
1	0	*Micropterus salmoides*	Centrarchidae	10	1	0	0	0	1	1	0	0	1	0	0	0	4	3	7	2	4	4	2	2	8
1		*Lutjanus fulvus*	Lutjanidae	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	6	1	3	5	3	1	9

1		*Amatitlania nigrofasciata*	Cichlidae	3	1	1	0	0	0	0	0	1	0	0	0	0	3	2	4	2	1	3	1	2	6
1		*Amphilophus citrinellus*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	2	3	1	2	6
0		*Amphilophus labiatus*	Cichlidae	1	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	4	3	1	2	6
1	1	*Astronotus ocellatus*	Cichlidae	1	1	1	0	0	0	1	0	0	0	0	0	0	3	3	6	2	2	3	1	2	6
1	1	*Cichla ocellaris* ?	Cichlidae	4	1	1	0	1	0	1	0	0	0	0	0	0	4	3	7	2	4	3	1	2	6
1		*Cryptoheros spilurus*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	4	3	1	2	6
1		*Hemichromis elongatus*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	6	2	4	3	1	2	6
1		*Hypsophrys nicaraguensis*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	4	3	1	2	6
1		*Melanochromis johannii*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	3	2	3	1	2	6
1		*Oreochromis macrochir*	Cichlidae	3	1	0	0	0	1	0	0	1	1	0	0	0	4	3	1	3	4	3	1	2	6
1	1	*Oreochromis mossambicus*	Cichlidae	43	1	1	0	1	1	1	1	1	1	0	0	0	8	3	4	3	5	3	2	2	7
1		*Parachromis managuensis*	Cichlidae	4	1	1	0	0	0	0	0	0	0	0	0	0	2	3	6	2	4	3	1	2	6
1		*Pelvicachromis pulcher*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	5	2	4	3	2	2	7
0		*Pterophyllum* sp.	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	2	6	2	2	3	1	2	6
1		*Sarotherodon melanotheron*	Cichlidae	0	1	1	0	0	0	0	0	0	0	0	0	0	2	3	3	3	5	3	2	2	7
1		*Thorichthys meeki*	Cichlidae	1	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	4	3	1	2	6
1		*Tilapia rendalli*	Cichlidae	8	1	1	0	1	1	1	0	0	1	0	0	0	6	3	2	2	4	3	2	2	7
1	1	*Tilapia zillii*	Cichlidae	7	1	1	0	1	0	0	0	0	1	0	0	0	4	3	2	2	5	3	2	2	7
1		*Omobranchus ferox*	Blenniidae	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	4	2	3	3	3	1	7
1		*Mugilogobius cavifrons*	Gobiidae	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	6	2	3	3	3	1	7
	1	*Betta pugnax*	Osphronemidae	0	1	1	0	1	0	0	0	0	0	0	0	0	3	1	5	3	1	3	1	3	7
0		*Osphronemus goramy*	Osphronemidae	7	1	1	0	0	0	0	0	0	1	0	0	0	3	3	4	2	2	3	2	3	8
0		*Trichopodus leerii*	Osphronemidae	1	1	1	0	0	0	0	0	0	0	0	0	0	2	2	4	2	2	3	1	3	7
1	1	*Channa maculata/striata*	Channidae	7	1	1	0	0	0	0	0	0	1	0	0	0	3	3	7	2	2	5	1	3	9

Table S4. Parameter estimates from the best model of establishment success of non-native inland fishes in Hawaii and Guam. Included is the estimate for the fixed intercept (no family effect) and estimates for each family (random intercept).

Variable/Family	Level	Parameter estimate	Standard error
Intercept	Fixed	–0.24	0.99
Islands (history)	Continuous	0.46	0.19
Hypoxia tolerance	2	–2.56	1.92
Hypoxia tolerance	3	2.36	2.35
Adrianichthyidae	Random	–0.65	
Anguillidae	Random	–0.88	
Anostomidae	Random	–1.49	
Aplocheilidae	Random	–0.54	
Ariidae	Random	–1.49	
Belonidae	Random	2.79	
Blenniidae	Random	1.26	
Callichthyidae	Random	0.24	
Centrarchidae	Random	2.54	
Centropomidae	Random	–0.65	
Channidae	Random	–0.21	
Characidae	Random	–1.62	
Cichlidae	Random	3.76	
Clariidae	Random	0.56	
Clupeidae	Random	1.02	
Cobitidae	Random	0.01	
Cyprinidae	Random	0.20	
Fundulidae	Random	–0.54	
Gobiidae	Random	1.26	
Ictaluridae	Random	0.14	
Kuhlidae	Random	–1.49	
Loricariidae	Random	0.20	
Lutjanidae	Random	1.26	
Mochokidae	Random	–0.54	
Moronidae	Random	–1.49	
Nothobranchiidae	Random	–0.54	
Osphronemidae	Random	–3.48	
Osteoglossidae	Random	–0.54	
Pangasiidae	Random	–3.42	
Plecoglossidae	Random	–1.49	
Poeciliidae	Random	2.11	
Salmonidae	Random	–1.76	
Synbranchidae	Random	0.24	