Adult and larval traits as determinants of geographic range size among tropical reef fishes

Osmar J. Luiz[a,1], Andrew P. Allen[a], D. Ross Robertson[b], Sergio R. Floeter[c], Michel Kulbicki[d], Laurent Vigliola[e], Ronan Becheler[f], and Joshua S. Madin[a]

[a]Department of Biological Sciences, Macquarie University, Sydney, NSW 2109, Australia; [b]Smithsonian Tropical Research Institute, Balboa, Republic of Panama APO AA 34002; [c]Departamento de Ecologia e Zoologia, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina 88040-900, Brazil; [d]LABEX Laboratoire Excellence Arago, Institut de Recherche pour le Dévelopment UR227 CoReUs, 66651 Banyuls, France; [e]LABEX Laboratoire Excellence Récifs Coralliens, Institut de Recherche pour le Dévelopment UR227 CoReUs, 98848 Noumea, New Caledonia; and [f]Laboratoire Environnement Profond, Ifremer, 29280 Plouzané, France

Edited by Mark A. Hixon, Oregon State University, Corvallis, OR, and accepted by the Editorial Board August 27, 2013 (received for review March 5, 2013)

Most marine organisms disperse via ocean currents as larvae, so it is often assumed that larval-stage duration is the primary determinant of geographic range size. However, empirical tests of this relationship have yielded mixed results, and alternative hypotheses have rarely been considered. Here we assess the relative influence of adult and larval-traits on geographic range size using a global dataset encompassing 590 species of tropical reef fishes in 47 families, the largest compilation of such data to date for any marine group. We analyze this database using linear mixed-effect models to control for phylogeny and geographical limits on range size. Our analysis indicates that three adult traits likely to affect the capacity of new colonizers to survive and establish reproductive populations (body size, schooling behavior, and nocturnal activity) are equal or better predictors of geographic range size than pelagic larval duration. We conclude that adult life-history traits that affect the postdispersal persistence of new populations are primary determinants of successful range extension and, consequently, of geographic range size among tropical reef fishes.

macroecology | marine dispersal | colonization

Geographic range size is a fundamental biogeographic variable that, among other effects (1, 2), strongly influences a species susceptibility to extinction (3, 4). Because most marine organisms disperse as larval propagules transported by ocean currents, it is often assumed that the duration of the larval stage is the fundamental determinant of their dispersal ability, and hence their range size (5, 6). Tropical reef fishes have geographic ranges that vary greatly in size, from a few square kilometers around tiny isolated islands to entire ocean basins (7–9). Given that pelagic larval duration (PLD) also varies greatly among such fishes, from only a few days to many months, the effects of PLD on dispersal potential became an early focus of investigation on general determinants of range size among those fishes and other near-shore marine species (10–12). However, although it has become evident that PLD is unlikely to be a primary determinant of geographic range size (13–16), alternative hypotheses have only recently begun to be considered (9).

To expand its geographic range, a species must successfully colonize new areas following the dispersal of its propagules (17). Consequently, attributes other than pelagic dispersal capacity may largely determine how widely reef fishes are distributed geographically (9). Here we assess the relative importance of seven adult and larval traits in influencing geographic range sizes of tropical reef fishes at the global scale. We do so using data from 590 species of tropical reef fishes in 47 families, the largest compilation of such data currently available for any marine group (Dataset S1). Traits directly linked to larval dispersal potential include PLD and spawning mode. Adult traits include maximum body size, schooling behavior, nocturnal activity, use of multiple habitat types, and adult depth range. The adult-biology traits chosen are not directly related to larval dispersal potential, but may influence the propensity for range expansion by affecting the establishment and persistence of new populations, as suggested by a recent study on Atlantic reef fishes (9). For example, schooling (18, 19) and nocturnal activity (20) reduce predation risk and thereby increase the chance of post-settlement survival. Broad habitat use and depth range indicate ecological generality, which is thought to influence establishment success in new environments (21). Finally, body size is linked to both predation risk and ecological generality (22).

Evaluation of these hypotheses is challenging because species traits are phylogenetically nonindependent (23) and unevenly distributed among families. Previous studies of dispersal–range-size relationships have controlled for effects of phylogeny, and limits on range-size imposed by ocean-basin size, by separately analyzing subsets of data (7, 16). However, this approach reduces statistical power (23, 24) and the ability to assess the generality of the effects of different factors. Our analysis controls for the nonindependence of shared traits among related species by using linear mixed-effects modeling (LMM) treating family and genus as nested random effects (9, 23). Our analysis includes species from three different regions that vary greatly in maximum (longitudinal or latitudinal) extent: the Indo-Central Pacific (ICP; ~22,000 km), the tropical Atlantic (TA; ~12,000 km), and the tropical eastern Pacific (TEP; ~5,000 km). To control for this variation, we include region and its interactions with other variables as fixed effects in our models. Modeling the data in this way, we are unique in being able to assess the relative importance of various adult and larval traits as determinants of range size among tropical reef-fish, as a group, at the global scale.

Significance

Marine organisms disperse mostly by ocean currents as larval propagules. Therefore, it is commonly thought that the duration of the larval stage is the fundamental determinant of geographic range size. Using a global compilation of reef fish traits, we test an alternative hypothesis: adult traits associated with population establishment and persistence in novel areas are better predictors of geographic range size than larval traits. We conclude that colonization success is as primary determinant of successful range extension and of geographic range size among tropical reef fishes.

Author contributions: O.J.L. and J.S.M. designed research; O.J.L., D.R.R., and J.S.M. performed research; O.J.L., A.P.A., D.R.R., S.R.F., M.K., L.V., R.B., and J.S.M. analyzed data; and O.J.L., A.P.A., D.R.R., S.R.F., M.K., L.V., R.B., and J.S.M. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission. M.A.H. is a guest editor invited by the Editorial Board.

Freely available online through the PNAS open access option.

[1]To whom correspondence should be addressed. E-mail: osmarluizjr@gmail.com.

This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1304074110/-/DCSupplemental.

Results and Discussion

Our analysis shows that region is the most significant predictor of geographic range size (Table 1). This result could be because of constraints of regional extent on range size within a region, or to differences in the underlying structure of the range-size frequency distribution within each region. To assess the importance of regional extent, we repeated the analysis after expressing the range size of each species as the ratio between the range size of species and the extent of the region. When range sizes were standardized in this way, all effects of species traits were maintained, and the region effect declined from the most important to the least important predictor (Table 1).

Our analysis also shows that three of five adult life-history traits—body size, schooling behavior, and nocturnal activity—are significant predictors of geographic range size (Figs. 1 and 2) for the global dataset (Table 2). Although PLD is also a significant predictor of range size at the global scale, only the largest of the three regions, the ICP, showed such a correlation (Table 2 and Table S1), confirming the finding of a previous analysis (7). The ICP correlation is largely driven by the few transpacific species that cross the world's largest oceanic barrier, the 4,000+-km-wide Eastern Pacific Barrier (EPB) that separates the ICP from the TEP (7). After the removal of those trans-Pacific species, the effect of PLD dropped from the second-most influential factor, globally, to the least-important trait (Table 1). A recent analysis of global ocean circulation patterns and habitat distributions (16) indicates that larvae of most tropical-reef species have PLDs sufficient to reach most habitat patches. Our results are consistent with that analysis: they show that the PLD effect is evident only at the largest spatial scale and when habitat patches are most isolated.

Our analysis provides further evidence for the view that range extensions are strongly influenced by adult life-history traits (9), factors likely to affect the capacity of new colonizers to survive and establish reproductive populations. All three of the positive adult-biology correlates of range size we identified—maximum body size, schooling behavior, and nocturnal activity—may enhance the probability of population establishment after propagule arrival.

Predation is one of the main processes influencing the structure and species composition of ecological communities (25), especially assemblages of coral reef fishes (26). If these factors limit the number of locally coexisting species (27, 28), predators may inhibit nonnative species establishment (29), and thereby constrain the geographic ranges of prey (30). Piscivorous predators are ubiquitous in coral reefs. Mortality is disproportionally higher among new recruits (31, 32), although juveniles and adults are not immune to predation, as evidenced by morphological, chemical and behavioral antipredatory mechanisms they use (26, 33). Among reef fishes, predation may be particularly important for species at early-stage colonization if predators tend to target rarer species (27, 34). Immigrant species may have better chances of survivorship and establishment if they can rely on specific antipredator mechanisms.

Reduction in predation risk is considered one of the main benefits of schooling in fish (35), and per capita mortality rates in schools of reef fishes decrease as school size increases (36). Predators are less successful at singling out individual prey from large schools because of the "confusion effect" (34). Survivorship may increase in both single-species schools and mixed-species schools not only through the confusion effect but also through more effective foraging by social observation, better vigilance for predators, and greater economy of time budgeting (35). Mixed-species schools are common among recruiting juveniles of reef fishes, sometimes involving species with different diets, which reduces the competitive costs while retaining the benefits of social behavior (19). Schooling may also increase the chance of finding mates among a scarce cohort of colonizers, improve food detection, and enhance access to resources protected by territorial competitors (37, 38). Thus, schooling fishes may have greater relative potential for population establishment and persistence after reaching new areas.

Recently, direct evidence has emerged that diel activity patterns of reef fishes are influenced by ongoing predation intensity: day-active nocturnal fish were much more common at a predator-depleted atoll in the Central Pacific than at a neighboring atoll with a large population of predators (20). This finding supports the view that nocturnal activity allows prey to avoid interactions with day-active predators. Differences in the morphology and behavior of nocturnal and diurnal reef fishes also are consistent with reduced predation intensity at night (39). Nocturnal planktivores are relatively deep bodied and robust, in contrast to their more streamlined diurnal counterparts, and there is a general reduction of schooling at night (39). Whatever the ultimate reasons for the development of nocturnal activity among reef fishes, nocturnal species may be exposed to a smaller subset of predators than day-active fishes (26, 39).

Table 1. Significant variables ranked according to their independent effects

All species (n = 590)					Trans-Pacific species removed (n = 564)				
Variable	df	F value	P value	IE (%)	Variable	df	F value	P value	IE (%)
Geographic range size									
Region	2	117.83	<0.001	53.3	Region	2	104.80	<0.001	66.9
PLD	1	54.72	<0.001	17.3	Body size	1	31.44	<0.001	9.6
Body size	1	69.86	<0.001	15.5	Nocturnal	1	16.69	<0.001	8.4
Nocturnal	1	18.22	<0.001	7.8	Schooling	1	15.45	<0.001	8.0
Schooling	1	12.63	<0.001	6.0	PLD	1	12.23	<0.001	6.9
Ratio between the species range size and region size									
Body size	1	111.70	<0.001	37.6	Body size	1	90.06	<0.001	36.0
PLD	1	23.28	<0.001	24.8	Nocturnal	1	38.13	<0.001	25.9
Nocturnal	1	33.17	<0.001	19.4	Schooling	1	12.94	<0.001	16.2
Schooling	1	11.47	<0.001	13.9	PLD	1	11.62	0.001	13.3
Region	2	2.09	0.123	4.2	Region	2	3.48	0.031	8.3

The independent effects (IE) value corresponds to the percentage of the explained variance accounted for by each explanatory variable as calculated using hierarchical partitioning. In Geographic range size, ranking is according to IE on geographic range size. In the ratio between the species range size and region size ranking is according to IE on the ratio between the species range size and region size. Degrees of freedom (df), test statistics (F value), and probabilities (P value) are listed for each coefficient in each model.

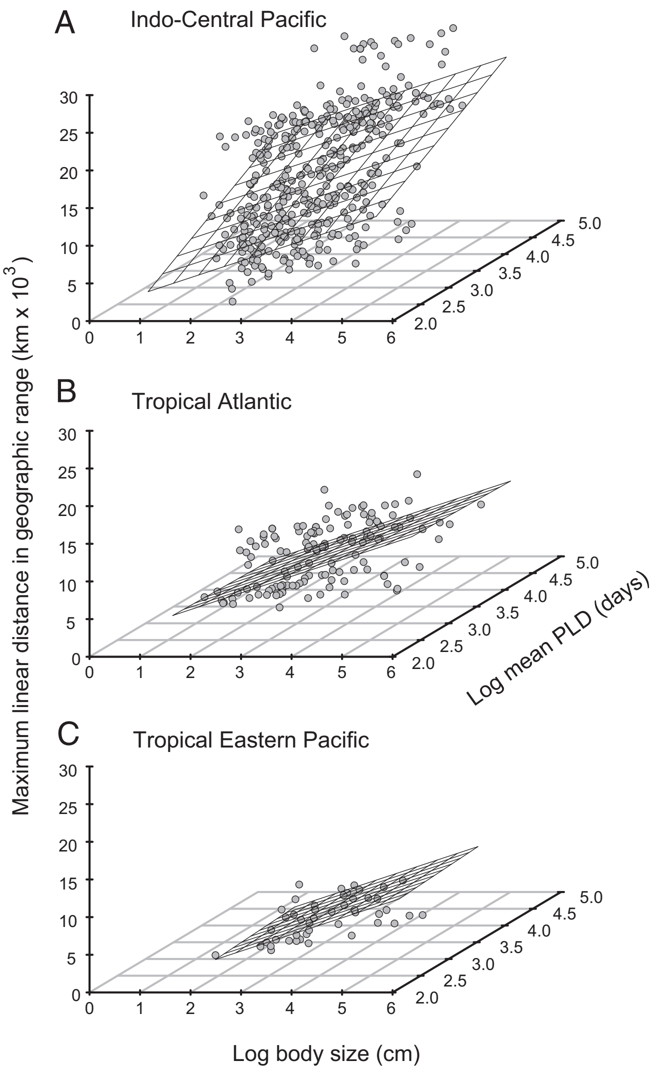

Fig. 1. Relationships among geographic range size, body size and mean PLD. (*A*) Indo-Central Pacific, (*B*) tropical Atlantic, (*C*) tropical eastern Pacific. The regression plane is the prediction from the LMM. Points represent the observed data.

Positive relationships between body size and range size have been documented for diverse taxonomic groups of both terrestrial and marine organisms (2). Larger fish species are generally less susceptible to predation than smaller species (22, 31). Mortality rate of reef fishes are high immediately following settlement of the larval stage, regardless of adult size (26, 31–33). However, juveniles of large species tend to grow faster than those of smaller species (31, 40, 41), allowing them to quickly reach a size refuge (31). Furthermore, large species can generally use a broader range of food types, and are more tolerant of environmental variability than small species (22, 42). Finally, in general, body size is positively correlated with longevity among marine fishes (43). This relationship may influence species establishment and persistence at new range outposts by reducing the probability of local extinction between sporadic long-distance recruitment (44) (i.e., the "storage effect").

Broad habitat use and depth range, both assumed to indicate ecological generality, were not significant correlates of geographic range size in our analysis. Analyses of ecological generality as a predictor of establishment success, mainly among birds, have produced mixed outcomes (45). In a previous study of the likelihood of reef fish crossing dispersal barriers in the Atlantic Ocean (9), broad habitat use correlated with crossing a coastal barrier within which adults of generalist species likely can survive, but not with crossing the Atlantic Ocean, where only pelagic propagules can succeed. Therefore, habitat generality may be important for only a specific type of barrier, which in turn may account for its lack of global relevance as a predictor of range size. Depth range and spawning mode had no statistical effect in either this study or the study on dispersal barriers in the Atlantic (9).

There are differences in the geographic distribution of reef habitat in the three ocean regions that might be expected to produce differences in factors affecting range size. The ICP consists of a vast network of islands and continental coastlines separated by less than 900 km (46), except for the ~2,000 km isolation of peripheral islands like Hawaii and Easter Island. The TEP and TA are dominated by relatively continuous continental coastlines, with patches of nonreef habitats separating biogeographically distinct provinces within each region (9, 47) and a few isolated oceanic islands separated by ocean gaps up to ~1,000 km. The TA is the only region with a large central ocean gap, the 3,500+-km-wide Atlantic. Despite these interregional differences in habitat geography, the same three adult traits (schooling, nocturnal activity, and large size) influence range size in all three ocean regions (Figs. 1 and 2), emphasizing the importance of these traits and colonization ability globally.

We conclude that adult life-history traits that enhance the probability of population establishment and persistence are important determinants of the potential for successful range extension by tropical reef fishes in general. The implication of our results is that factors affecting species persistence in new range outposts are more important for determining the size of geographic ranges than larval dispersal potential (17). The exception relates to the relatively uncommon crossings of the world's largest oceanic barrier, the EPB (48), where the PLD does have a prominent role. Our analysis has implications not only for biogeographic analyses but also for understanding the effects of climate change. Predictions of poleward range shifts by marine

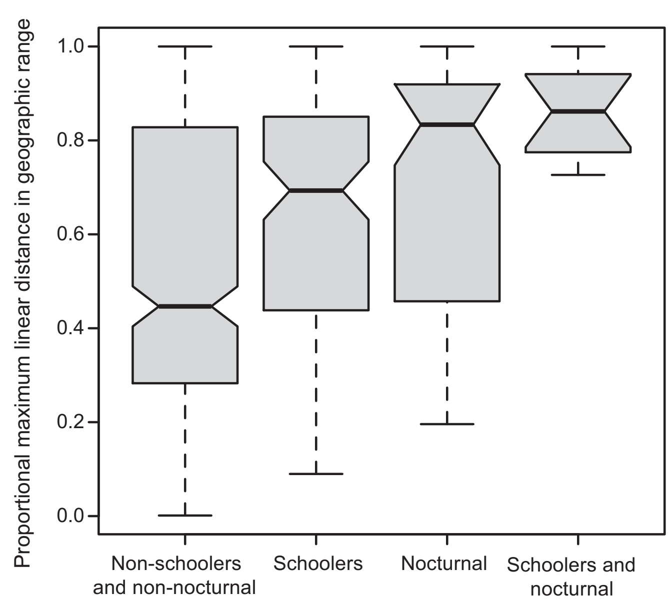

Fig. 2. Effects of schooling behavior and nocturnal activity on the ratio between the range size of species and the extent of the region. Dashed vertical lines, gray bars, and black horizontal lines represent, respectively, data range, interquartile range, and median. Nonoverlapping notches among the gray bars signify a difference at the 95% confidence level.

Table 2. Parameters of the final predictive LMM

Variable	Estimate	SE	*t* value	*P* value
Intercept	987.76	4425.75	0.223	0.823
Body size	**2210.34**	335.41	6.589	<0.001
Schooling behavior	**2030.28**	609.71	3.329	0.001
Nocturnal activity	**2503.27**	881.27	2.840	0.004
PLD: Tropical Atlantic	−247.54	1295.63	−0.191	0.848
PLD: Indo-Central Pacific	**4935.42**	1434.00	3.441	<0.001
PLD: Tropical Eastern Pacific	501.14	2406.30	0.208	0.835
Region: Indo-Central Pacific	**-10483.26**	4915.94	−2.132	0.033
Region: Tropical Eastern Pacific	−5102.71	8397.86	−0.607	0.543

Parameters estimated in a LMM with MLD of geographical range size (in kilometers) as the response variable for larval and adult traits including an interaction between PLD and biogeographic region, and genus nested within family as a random variable. Estimate, coefficient estimate of explanatory variables; SE, test statistic (*t* value) and probability (*P* value). *P* values are significant ($P < 0.05$) for coefficients if in bold. Reference levels for this regression were set as "Tropical Atlantic" for region and as "no" for both schooling behavior and nocturnal activity.

species in response to ocean warming have been based on their thermo-physiological tolerances (49). However, our results indicate other life-history traits that may constrain range extension and thereby influence extinction risks (4).

Materials and Methods

Species Traits. We selected life-history traits that are thought to potentially influence range sizes (2, 9), and for which data are readily available for all species for which we also have PLD data. Body size is correlated with many other biological attributes of species, including range size (2). Schooling behavior and nocturnal activity are mechanisms that may diminish predation risk (18–20), and thereby enhance range expansion by assisting colonization. Environmental generalist species might be expected to have greater establishment success than specialists in new and different environments (21). Here, such generalists included species that have larger depth ranges and those that use other habitats in addition to structural reefs (soft bottoms, seagrass/macroalgae beds, mangroves, and estuaries).

PLD is linked to the time larvae are susceptible to pelagic dispersal. Spawning mode (production of pelagic or benthic eggs), besides acting as a proxy for PLD (9), influences the stage of development at which larvae enter the pelagic zone. The eggs of pelagic spawners are immediately subjected to transport by currents, whereas the eggs of benthic spawners are deposited on the substrate and the larvae enter the pelagic realm only after developing for some time in the egg before hatching. Existing data on tropical reef fish PLD were compiled from the primary literature for 446 species (see references in Dataset S1). Additional data on PLDs were obtained for 227 species, from which 144 are uniquely reported, by aging settlers through analyses of daily growth increments and settlement marks in otoliths (50). Because of a lack of sufficient data in one or more regions we did not include one other factor that we assessed in our study of range expansion across large barriers in the Atlantic Ocean (9): flotsam-rafting behavior by postlarval stages. Data on spawning mode, maximum total length (our metric for body size), depth range, schooling behavior, multi-habitat use, and nocturnal activity were obtained from the primary literature and the global fish data aggregator FishBase (www.fishbase.org). We considered schooling species to be those that regularly form polarized, cohesive groups of 20 or more individuals. Diurnal and nocturnal were defined by the main period of day that each species actively forages.

Geographic Range. For comparability with previous studies we used the linear distance between the farthest two range endpoints—maximum linear distance (MLD) in kilometers—as a metric of geographic range size (7, 16). Those studies found that the MLD of range size is strongly correlated with the combined maximum latitudinal and longitudinal extent of ranges, and they considered MLD to represent an adequate descriptor of a species' geographic extent (7). Data on species range limits were obtained from guidebooks (51–55) and from the Ocean Biogeographic Information System (OBIS), a global aggregator of geo-referenced collection records (www.iobis.org). Data from both FishBase and OBIS were screened by us and complemented from our own records (56) (Dataset S1). Endpoint geographic coordinates were determined to the nearest degree using Google Earth (earth.google.com). The MLD was measured using the function "geodist" in the R package "gmt" (57). Species were grouped in terms of their residence in three well-defined biogeographic regions, the physical dimensions of which delineate the maximum attainable range size in each region: the Indo-central Pacific region (from the Red Sea to Easter Island), the tropical Atlantic (from the northwest Gulf of Mexico to the southern Gulf of Guinea), and the tropical eastern Pacific (from the northern Gulf of California to northern Peru). Primarily tropical species that extend their ranges to temperate zones had their full range considered in the analysis. Although it is in the Pacific, together with the ICP, the TEP is a well-recognized biogeographic entity that has a substantial fauna with a high level of endemism (~75%) (47). Only TEP endemics were included in the TEP group in our analyses, which avoided possible confounding effects of recent trans-Pacific crossers not having realized their full range potential in that region. The few trans-Pacific species that occur in both the ICP and TEP were included as members of the ICP fauna because most of the range of each is in the ICP and most appear to have migrated from there to the TEP (48). We did not consider the western and eastern sides of the TA as separate regions because there are insufficient data on the PLDs of species endemic to the tropical eastern Atlantic, which has a substantially lower rate of endemism than the tropical western Atlantic (58).

Statistical Analysis. The LMM was fitted using the function "lme" from the package "nlme" (59) in R. The response variable was the MLD between two points along the geographic range boundary. PLD, spawning mode, maximum body size, schooling behavior, nocturnal activity, depth range, multi-habitat use, and region were included as fixed variables, and genus and family were included as nested random variables. Interactions between region and each fixed factor were considered in the full model. For model selection, we followed the procedure recommended by Zuur et al. (60) of a backward stepwise removal of nonsignificant fixed-effect terms ($P > 0.05$) from the full model based on log-likelihood ratio tests (Table S1). Partitioning of variance to determine the relative importance (percent of explained variance; independent effects in Table 1) accounted for by each explanatory variable in the model was calculated by hierarchical partitioning using the R package "hier.part" (61).

ACKNOWLEDGMENTS. We thank R. Lecomte for her assistance with otholith work and for giving access to her laboratory facilities; C. Osenberg, C. St. Mary, T. Adam, B. Chockley, and many volunteers for their assistance in the field and at the laboratory; and Mark Hixon and two anonymous reviewers for comments in the manuscript. This study was supported in part by an International Macquarie University Research Excellence Scholarship (to O.J.L.); the Smithsonian Tropical Research Institute (D.R.R.); the SISBIOTA program by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (S.R.F.); and the Australian Research Council (J.S.M.). The Fondation de la Recherche pour la Biodiversité funded this research through the "Résilience de communautés: rôle du couplage entre diversités taxonomique et fonctionnelle, les poissons de récif pour modèle" (RESICOD) program and the General Approach to Species-Abundance Relationships (GASPAR) program. Part of the data were collected through US National Sea Grant R/LR-B-52.

1. Gaston KJ (2003) *The Structure and Dynamics of Geographic Ranges* (Oxford Univ Press, Oxford).
2. Brown JH, Stevens GC, Kaufman DM (1996) The geographic range: Size, shape, boundaries, and internal structure. *Annu Rev Ecol Syst* 27:597–623.
3. Gaston KJ, Blackburn TM (2003) Macroecology and conservation biology. *Macroecology: Concepts and Consequences*, eds Blackburn TM, Gaston KJ (Blackwell, Oxford), pp 345–367.
4. Thomas CD, et al. (2004) Extinction risk from climate change. *Nature* 427(6970):145–148.
5. Shanks AL, Grantham BA, Carr MH (2003) Propagule dispersal distance and the size and spacing of marine reserves. *Ecol Appl* 13(S1):S159–S169.
6. Lindsay SM (2012) Dispersal of marine organisms and the grand challenges in biology: An introduction to the symposium. *Integr Comp Biol* 52(4):443–446.
7. Lester SE, Ruttenberg BI (2005) The relationship between pelagic larval duration and range size in tropical reef fishes: A synthetic analysis. *Proc Biol Sci* 272(1563):585–591.
8. Victor BC, Wellington GM (2000) Endemism and the pelagic larval duration of reef fishes in the eastern Pacific Ocean. *Mar Ecol Prog Ser* 205:241–248.
9. Luiz OJ, et al. (2012) Ecological traits influencing range expansion across large oceanic dispersal barriers: Insights from tropical Atlantic reef fishes. *Proc Biol Sci* 279(1730):1033–1040.
10. Brothers EB, Thresher RE (1985) Pelagic duration, dispersal and the distribution of Indo-Pacific coral reef fishes. *The Ecology of Coral Reefs*, ed Reaka ML (US Depart of Commerce, Washington, DC), pp 53–69.
11. Thresher RE, Brothers EB (1985) Reproductive ecology and biogeography of Indo-West Pacific angelfishes (Pisces: Pomacanthidae). *Evolution* 39(4):878–887.

12. Thresher RE, Colin PL, Bell LJ (1989) Planktonic duration, distribution and population structure of western and central Pacific damselfishes (Pomacentridae). *Copeia* 1989(2):420–434.
13. Lester SE, Ruttenberg BI, Gaines SD, Kinlan BP (2007) The relationship between dispersal ability and geographic range size. *Ecol Lett* 10(8):745–758.
14. Paulay G, Meyer C (2006) Dispersal and divergence across the greatest ocean region: Do larvae matter? *Integr Comp Biol* 46(3):269–281.
15. Selkoe K, Toonen RJ (2011) Marine connectivity: A new look at pelagic larval duration and genetic metrics of dispersal. *Mar Ecol Prog Ser* 436:291–305.
16. Mora C, et al. (2012) High connectivity among habitats precludes the relationship between dispersal and range size in tropical reef fishes. *Ecography* 35(1):89–96.
17. Marshall DJ, Monro K, Bode M, Keough MJ, Swearer S (2010) Phenotype-environment mismatches reduce connectivity in the sea. *Ecol Lett* 13(1):128–140.
18. Sandin SA, Pacala SW (2005) Fish aggregation results in inversely density-dependent predation on continuous coral reefs. *Ecology* 86(6):1520–1530.
19. DeMartini EE, Anderson TW, Friedlander AM, Beets JP (2011) Predator biomass, prey density, and species composition effects on group size in recruit coral reef fishes. *Mar Biol* 158(11):2437–2447.
20. McCauley DJ, Hoffmann E, Young HS, Micheli F (2012) Night shift: Expansion of temporal niche use following reductions in predator density. *PLoS ONE* 7(6):e38871.
21. Cassey P, Blackburn TM, Sol D, Duncan RP, Lockwood JL (2004) Global patterns of introduction effort and establishment success in birds. *Proc Biol Sci* 271(Suppl 6):S405–S408.
22. Munday PL, Jones GP (1998) The ecological implications of small body size among coral-reef fishes. *Oceanogr Mar Biol Annu Rev* 36:373–411.
23. Bunnefeld N, Phillimore AB (2012) Island, archipelago and taxon effects: Mixed models as a means of dealing with the imperfect design of nature's experiments. *Ecography* 35(1):15–22.
24. Hortal J (2012) Escaping the trap of low sample size in island biogeography. *Frontiers of Biogeography* 3(4):127–129.
25. Connell JH (1975) Some mechanisms producing structure in natural communities: A model and evidence from field experiments. *Ecology and Evolution of Communities*, eds Cody ML, Diamond JA (Belknap-Harvard Univ Press, Cambridge, MA), pp 460–490.
26. Hixon MA (1991) Predation as a process structuring coral reef fish communities. *The Ecology of Fishes on Coral Reefs*, ed Sale PF (Academic, San Diego), pp 475–508.
27. Almany GR, Webster MS (2004) Odd species out as predators reduce diversity of coral-reef fishes. *Ecology* 85(11):2933–2937.
28. Heinlein J, Stier A, Steele M (2010) Predators reduce abundance and species richness of coral reef fish recruits via non-selective predation. *Coral Reefs* 29(2):527–532.
29. Wanger TC, et al. (2011) Endemic predators, invasive prey and native diversity. *Proc Biol Sci* 278(1706):690–694.
30. Holt RD, Barfield M, Filin I, Forde S (2011) Predation and the evolutionary dynamics of species ranges. *Am Nat* 178(4):488–500.
31. Sogard SM (1997) Size-selective mortality in the juvenile stage of teleost fishes: A review. *Bull Mar Sci* 60(3):1129–1157.
32. Almany GR, Webster MS (2006) The predation gauntlet: Early post-settlement mortality in reef fishes. *Coral Reefs* 25(1):19–22.
33. Webster MS (2002) Role of predators in the early post-settlement demography of coral-reef fishes. *Oecologia* 131(1):52–60.
34. Almany GR, Peacock LF, Syms C, McCormick MI, Jones GP (2007) Predators target rare prey in coral reef fish assemblages. *Oecologia* 152(4):751–761.
35. Pitcher TJ, Parrish JK (1993) Function of shoaling behaviour in teleosts. *Behaviour of Teleost Fishes*, ed Pitcher TJ (Chapman & Hall, London), pp 363–439.
36. White JW, et al. (2010) Synthesizing mechanisms of density dependence in reef fishes: Behavior, habitat configuration, and observational scale. *Ecology* 91(7):1949–1961.
37. Pitcher TJ, Magurran AE, Winfield IJ (1982) Fish in larger shoals find food faster. *Behav Ecol Sociobiol* 10(2):149–151.
38. Robertson DR, Swetman HPA, Fletcher EA, Cleland MG (1976) Schooling as a mechanism for circumventing the territoriality of competitors. *Ecology* 57(6):1208–1220.
39. Helfman GS (1993) Fish behaviour by day, night and twilight. *Behaviour of Teleost Fishes*, ed Pitcher TJ (Chapman & Hall, London), pp 479–511.
40. Buesa RJ (1987) Growth rate of tropical demersal fishes. *Mar Ecol Prog Ser* 36:191–199.
41. Legendre M, Albaret JJ (1991) Maximum observed length as an indicator of growth rate in tropical fishes. *Aquaculture* 94(4):327–341.
42. Robertson DR (1998) Implications of body size for interspecific interactions and assemblage organization among coral-reef fishes. *Aust J Ecol* 23(3):252–257.
43. Roff DA (1992) *The Evolution of Life Histories: Theory and Analysis* (Chapman & Hall, New York).
44. Warner RR, Chesson PL (1985) Coexistence mediated by recruitment fluctuations: A field guide to the storage effect. *Am Nat* 125(6):769–787.
45. Duncan RP, Blackburn TM, Sol D (2003) The ecology of bird introductions. *Annu Rev Ecol Syst* 34:71–98.
46. Schultz JK, et al. (2008) Global phylogeography and seascape genetics of the lemon sharks (genus *Negaprion*). *Mol Ecol* 17(24):5336–5348.
47. Robertson DR, Cramer KL (2009) Shore fishes and biogeographic subdivisions of the Tropical Eastern Pacific. *Mar Ecol Prog Ser* 380:1–17.
48. Lessios HA, Robertson DR (2006) Crossing the impassable: Genetic connections in 20 reef fishes across the eastern Pacific barrier. *Proc Biol Sci* 273(1598):2201–2208.
49. Sunday JM, Bates AE, Dulvy NK (2012) Thermal tolerance and the global redistribution of animals. *Nature Climate Change* 2:686–690.
50. Wilson DT, McCormick MI (1999) Microstructure of settlement-marks in the otoliths of tropical reef fishes. *Mar Biol* 134(1):29–41.
51. Randall JE (1996) *Caribbean Reef Fishes* (TFH Publications, Neptune City, NJ), 3rd Ed.
52. Robertson DR, Van Tassel J (2012) *Fishes: Greater Caribbean. An identification Guide to the Shore-Fish Fauna of the Caribbean and Adjacent Areas.* (iOS App. Copyright Smithsonian Institution, Left Coast R&C, Santa Cruz, California). Available at https://itunes.apple.com/us/app/fishes-greater-caribbean/id570048678?mt=8. Accessed September 2012.
53. Robertson DR, Allen G (2012) *Fishes: East Pacific. An Identification Guide to the Shore-Fish Fauna of the Tropical Eastern Pacific.* (iOS App. Copyright Smithsonian Institution, Left Coast R&C, Santa Cruz, California). Available at https://itunes.apple.com/us/app/fishes-east-pacific/id494644648?mt=8. Accessed September 2012.
54. Allen G, Steene R, Humann P, DeLoach N (2003) *Reef Fish Identification: Tropical Pacific* (New World Publications, Jacksonville, FL).
55. Allen G, Erdmann MV (2012) *Reef Fishes of the East Indies* (Univ of Hawaii Press, Honolulu).
56. Robertson DR (2008) Global biogeographical data bases on marine fishes: Caveat emptor. *Divers Distrib* 14(6):891–892.
57. Magnusson A (2011) *gmt: Interface Between GMT Map-Making Software and R.* R package v1.1-9 Available at http://cran.r-project.org/web/packages/gmt/index.html. Accessed April 2012.
58. Floeter SR, et al. (2008) Atlantic reef fish biogeography and evolution. *J Biogeogr* 35(1):22–47.
59. Pinheiro J, Bates D, DebRoy S, Sarkar D (2012) *nlme: Linear and Nonlinear Mixed Effects Models.* R package v3.1-104. Available at http://cran.r-project.org/web/packages/nlme/index.html. Accessed November 2011.
60. Zuur AF, Ieno EN, Walker NJ, Saveliev AA, Smith GM (2009) *Mixed Effects Models and Extensions in Ecology with R* (Springer, New York, NY).
61. Walsh C, MacNally R (2013) *hier.part: Hierarquical partitioning.* R package v1.0-4. Available at http://cran.r-project.org/web/packages/hier.part/index.html. Accessed January 2013.

Supporting Information

Luiz et al. 10.1073/pnas.1304074110

Table S1. Model selection for the effect of dropping the interaction of region with each variable and the effect of dropping variables in a backward stepwise manner

Variables	AIC	*P* value for retention
Interactions		
Full model	11794.14	
Region* body size	11786.39	0.509
Region* schooling behavior	11787.01	0.373
Region* depth range	11785.86	0.664
Region* multihabitat use	11791.01	0.704
Region* nocturnal activity	11787.62	0.276
Region* pelagic larval duration (PLD)	11795.10	**0.006**
Region* spawning Mode	11785.47	0.809
Single factors		
Region*PLD + body size + schooling + nocturnal + depth + spawn + habitat	11781.22	
Region*PLD + body size + schooling + nocturnal + depth + spawn	11779.84	0.677
Region*PLD + body size + schooling + nocturnal + depth	11778.20	0.326
Region*PLD + body size + schooling + nocturnal	11779.92	0.060
Region*PLD + body Size + schooling	11784.63	**0.009**
Region*PLD + body Size + nocturnal	11788.85	**<0.001**
Region*PLD + schooling + nocturnal	11817.86	**<0.001**

The selected model (only significant variables retained) is indicated in bold. The *P* value shown in each line refers to the significance for the retention of the factor excluded. Shown are Akaike information criteria (AIC) and significance (*P* value). *P* values in bold are significant ($P < 0.05$).

Other Supporting Information Files

Dataset S1 (PDF)

Dataset S1 – Species used in analyses in this study, examined by literature reviewed in the present study. **Region:** biogeographic region which a species resides; ICP = Indo-Central Pacific; TA = Tropical Atlantic; TEP = Tropical Eastern Atlantic. **Body size:** maximum total length. **Mean PLD:** average of the PLD values observed in the literature and/or collected for this study. **Depth range:** breadth between the minimum and maximum depth recorded. **Schooler:** if is known to form schools; school is defined as cohesive and polarized groups of 20 or more individuals. **Spawn:** type of egg release; DEM = demersal; PEL = pelagic. **Nocturnal:** if is known to actively forage at night. **Transpacific:** Such species occur in both the ICP and in the TEP [Robertson, D .R., Grove, J. S. & McCosker, J. E. 2004 Tropical transpacific shore fishes. *Pac. Sci.* **58,** 507–565], although we treat then as part of the ICP fauna as the most of their ranges are found in the ICP. **Multi-habitat:** Species that use other habitats in addition to structural reefs (soft bottoms, seagrass/macroalgae beds, mangroves and/or estuaries). **Reference:** A list of references used in this table is provided in appendix 1. PS = Present Study, species in which new data on PLD was used in addition to the literature. * = Species with mean PLD reported for the first time in the literature. **Notes:** 1. Distributional records from online databases contain many errors [Robertson, D. R. 2008 Global biogeographic databases on marine fishes: caveat emptor. *Divers. Distrib.* **14,** 891–892]. Hence we vigorously screened all records obtained from such those sources using guidebooks by professional scientists, and recent taxonomic revisions and faunal lists for localities published in refereed journals. We also reviewed outliers in the OBIS database to assess validity; e.g. records of shallow species in deep water were likely larvae. 2. *Acanthochromis polyacanthus*, a species that does not have larval pelagic phase (PLD = 0) was considered an outlier and excluded from analyses.

Family	Genus	Species	Region	Range size (km)	Body size (cm)	Mean PLD (days)	Depth range (m)	Schooler	Spawn	Nocturnal	Multi-habitat	Transpacific	Reference
ACANTHURIDAE	Acanthurus	bahianus	TA	8948	35	52.3	38	YES	PEL	NO	YES	NO	1
ACANTHURIDAE	Acanthurus	chirurgus	TA	10477	34	55.2	23	YES	PEL	NO	YES	NO	1
ACANTHURIDAE	Acanthurus	coeruleus	TA	10477	36	51.6	38	YES	PEL	NO	YES	NO	1
ACANTHURIDAE	Acanthurus	lineatus	ICP	17970	38	39.5	15	YES	PEL	NO	NO	NO	2
ACANTHURIDAE	Acanthurus	nigricans	ICP	18153	21	59.7	66	NO	PEL	NO	NO	YES	2
ACANTHURIDAE	Acanthurus	nigrofuscus	ICP	19500	21	31	25	YES	PEL	NO	NO	NO	3
ACANTHURIDAE	Acanthurus	olivaceus	ICP	12355	35	59.65	43	YES	PEL	NO	YES	NO	3,PS
ACANTHURIDAE	Acanthurus	tractus	TA	3819	35	52.3	38	YES	PEL	NO	YES	NO	1
ACANTHURIDAE	Acanthurus	triostegus	ICP	27891	27	47.4	90	YES	PEL	NO	NO	YES	2,PS
ACANTHURIDAE	Ctenochaetus	binotatus	ICP	17970	22	58.5	45	NO	PEL	NO	NO	NO	3,4
ACANTHURIDAE	Ctenochaetus	flavicauda	ICP	3793	11.8	31	30	NO	PEL	NO	NO	NO	PS*
ACANTHURIDAE	Ctenochaetus	striatus	ICP	17970	26	43.87	27	YES	PEL	NO	NO	NO	3,PS
ACANTHURIDAE	Naso	annulatus	ICP	24598	100	62.3	59	YES	PEL	NO	NO	YES	PS*
ACANTHURIDAE	Naso	brevirostris	ICP	26191	60	79.65	120	YES	PEL	NO	NO	YES	3
ACANTHURIDAE	Naso	hexacanthus	ICP	18323	75	91.2	144	YES	PEL	NO	NO	YES	3
ACANTHURIDAE	Naso	lituratus	ICP	21325	46	69.4	90	NO	PEL	NO	NO	YES	2
ACANTHURIDAE	Naso	unicornis	ICP	18323	70	73.9	179	NO	PEL	NO	NO	NO	3,PS
ACANTHURIDAE	Naso	vlamingii	ICP	19458	55	77.3	49	YES	PEL	NO	NO	YES	PS*
ACANTHURIDAE	Paracanthurus	hepatus	ICP	17945	31	37	38	YES	PEL	NO	NO	NO	2
ACANTHURIDAE	Zebrasoma	flavescens	ICP	6244	20	54	44	NO	PEL	NO	NO	NO	PS*
ACANTHURIDAE	Zebrasoma	scopas	ICP	17970	40	55.2	59	NO	PEL	NO	NO	NO	3,PS
ACANTHURIDAE	Zebrasoma	veliferum	ICP	11000	40	35.75	29	NO	PEL	NO	NO	NO	2,PS
ANTENNARIIDAE	Antennarius	multiocellatus	TA	10924	20	54	66	NO	PEL	YES	NO	NO	PS*
ANTENNARIIDAE	Antennarius	tuberosus	ICP	19458	9	47.5	73	NO	PEL	YES	NO	NO	PS*
APOGONIDAE	Apogon	aurolineatus	TA	4199	6.4	19.5	75	NO	DEM	YES	YES	NO	PS*
APOGONIDAE	Apogon	binotatus	TA	4091	15	20.1	59	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	coccineus	ICP	20049	6	19.7	27	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	compressus	ICP	6305	12	24	18	NO	DEM	YES	NO	NO	5
APOGONIDAE	Apogon	crassiceps	ICP	20629	5	17.7	37	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	cyanosoma	ICP	4582	8	21.1	49	NO	DEM	YES	YES	NO	5,6
APOGONIDAE	Apogon	doederleini	ICP	8625	14	22.6	3	NO	DEM	YES	YES	NO	6
APOGONIDAE	Apogon	exostigma	ICP	19720	11	33.5	28	NO	DEM	YES	YES	NO	PS*
APOGONIDAE	Apogon	fraenatus	ICP	20629	11	25.3	47	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	imberbis	TA	9115	15	21.3	190	YES	DEM	YES	YES	NO	7
APOGONIDAE	Apogon	maculatus	TA	4199	11.1	20.7	128	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	nigrofasciatus	ICP	20629	8	18.5	34	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	novemfasciatus	ICP	11616	9	29.7	3	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	properuptus	ICP	8518	7.5	19.2	27	NO	DEM	YES	YES	NO	8
APOGONIDAE	Apogon	pseudomaculatus	TA	11294	8.9	26.8	99	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Apogon	quadrisquamatus	TA	10002	7	18.7	74	NO	DEM	YES	YES	NO	PS*
APOGONIDAE	Astrapogon	stellatus	TA	8784	8	20.2	39	NO	DEM	YES	YES	NO	PS*
APOGONIDAE	Cheilodipterus	macrodon	ICP	19720	25	16.3	40	NO	DEM	YES	NO	NO	8
APOGONIDAE	Cheilodipterus	quinquelineatus	ICP	20000	13	17.97	40	YES	DEM	YES	YES	NO	2,5,6
APOGONIDAE	Foa	brachygramma	ICP	18323	8	30.6	134	NO	DEM	YES	YES	NO	9
APOGONIDAE	Fowleria	marmorata	ICP	21011	9	41.3	37	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Gymnapogon	urospilotus	ICP	6771	3.6	34.6	7	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Nectamia	bandanensis	ICP	9792	9	24.5	24	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Phaeoptyx	pigmentaria	TA	10924	8	20	37	NO	DEM	YES	NO	NO	PS*
APOGONIDAE	Sphaeraemia	orbicularis	ICP	17945	10	17	5	YES	DEM	YES	YES	NO	2
AULOSTOMIDAE	Aulostomus	chinensis	ICP	27631	80	93.3	119	NO	PEL	NO	YES	YES	PS*
AULOSTOMIDAE	Aulostomus	strigosus	TA	6335	75	93	20	NO	PEL	NO	YES	NO	10
BALISTIDAE	Balistapus	undulatus	ICP	20629	30	51.3	48	NO	PEL	NO	NO	NO	PS*
BALISTIDAE	Balistes	vetula	TA	13940	50	75	273	NO	PEL	NO	YES	NO	11
BALISTIDAE	Balistoides	conspicillum	ICP	15924	26	36	74	NO	PEL	NO	NO	NO	2
BALISTIDAE	PSeudobalistes	flavimarginatus	ICP	20629	60	44.5	48	NO	PEL	NO	YES	NO	PS*
BALISTIDAE	Rhineacanthus	aculeatus	ICP	18323	30	45	50	NO	PEL	NO	NO	NO	2,PS

BALISTIDAE	Rhinecanthus	rectangulus	ICP	19500	30	43.5	10	NO	PEL	NO	NO	NO	2
BLENNIIDAE	Hypleurochilus	bermudensis	TA	3819	10.2	25.4	6	NO	DEM	NO	NO	NO	PS*
BLENNIIDAE	Ophioblennius	macclurei	TA	4199	20	38	8	NO	DEM	NO	NO	NO	10
BLENNIIDAE	Ophioblennius	steindachneri	TEP	5148	25	50	18	NO	DEM	NO	NO	NO	12
BLENNIIDAE	Parablennius	marmoreus	TA	10861	10.8	23.4	10	NO	DEM	NO	NO	NO	PS*
BLENNIIDAE	Parablennius	pilicornis	TA	10995	12.7	30.5	25	NO	DEM	NO	NO	NO	13
BLENNIIDAE	Petroscirtes	fallax	ICP	2530	9.5	21	15	NO	DEM	NO	NO	NO	6
BLENNIIDAE	Petroscirtes	mitratus	ICP	17000	8	24.5	15	NO	DEM	NO	YES	NO	6
BOTHIDAE	Bothus	mancus	ICP	27631	48	69.3	147	NO	PEL	NO	YES	YES	PS*
BOTHIDAE	Bothus	pantherinus	ICP	21011	30	63.7	147	NO	PEL	NO	YES	NO	PS*
BOTHIDAE	Bothus	podas	TA	9115	45	33.7	385	NO	PEL	NO	YES	NO	7
CAESIONIDAE	Caesio	caerulaurea	ICP	17390	35	22	45	YES	PEL	NO	NO	NO	PS*
CAESIONIDAE	Pterocaesio	chrysozona	ICP	13040	21	42	40	YES	PEL	NO	NO	NO	14
CAESIONIDAE	Pterocaesio	marri	ICP	19840	35	42	5	YES	PEL	NO	NO	NO	15
CALLIONYMIDAE	Synchiropus	splendidus	ICP	6800	6	36	17	NO	DEM	NO	YES	NO	2
CARANGIDAE	Atule	mate	ICP	19720	30	50	79	YES	PEL	NO	YES	NO	16
CARANGIDAE	Caranx	melampygus	ICP	19720	100	57.6	190	YES	PEL	NO	YES	YES	PS*
CARAPIDAE	Carapus	mourlani	ICP	21011	17	73	149	NO	PEL	YES	NO	NO	PS*
CARAPIDAE	Encheliophis	boraborensis	ICP	15611	30	50.2	149	NO	PEL	YES	NO	NO	PS*
CARAPIDAE	Encheliophis	gracilis	ICP	19720	27.5	74.6	61	NO	PEL	YES	NO	NO	PS*
CARAPIDAE	Encheliophis	homei	ICP	15611	19	79.9	30	NO	PEL	YES	NO	NO	PS*
CHAENOPSIDAE	Acanthemblemaria	aspera	TA	4091	4	20.7	12	NO	DEM	NO	NO	NO	PS*
CHAENOPSIDAE	Chaenopsis	limbaughi	TA	2582	8.2	30.5	15	NO	DEM	NO	YES	NO	PS*
CHAENOPSIDAE	Emblemaria	pandionis	TA	3819	7	25.3	11	NO	DEM	NO	YES	NO	PS*
CHAETODONTIDAE	Chaetodon	auriga	ICP	21500	23	44.27	34	NO	PEL	NO	YES	NO	2,3,17
CHAETODONTIDAE	Chaetodon	baronessa	ICP	8876	16	35.5	15	NO	PEL	NO	NO	NO	2,3
CHAETODONTIDAE	Chaetodon	capistratus	TA	4199	20	38	18	NO	PEL	NO	YES	NO	PS*
CHAETODONTIDAE	Chaetodon	citrinellus	ICP	18549	13	50.5	35	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	collare	ICP	7810	18	43	12	NO	PEL	NO	YES	NO	2
CHAETODONTIDAE	Chaetodon	ephippium	ICP	14637	23	38.5	30	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	flavirostris	ICP	8369	20	47.27	18	NO	PEL	NO	YES	NO	17
CHAETODONTIDAE	Chaetodon	kleinii	ICP	21500	15	56	57	NO	PEL	NO	NO	NO	2
CHAETODONTIDAE	Chaetodon	lineolatus	ICP	18323	30	54	169	NO	PEL	NO	NO	NO	2
CHAETODONTIDAE	Chaetodon	lunula	ICP	21500	21	43	30	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	lunulatus	ICP	11849	15	39.3	17	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	miliaris	ICP	1397	13	60	250	NO	PEL	NO	NO	NO	16
CHAETODONTIDAE	Chaetodon	ocellatus	TA	9391	15	35.5	30	NO	PEL	NO	YES	NO	PS*
CHAETODONTIDAE	Chaetodon	ornatissimus	ICP	16879	18	62.5	35	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	plebeius	ICP	10000	15	44	10	NO	PEL	NO	NO	NO	3,6,18
CHAETODONTIDAE	Chaetodon	rainfordi	ICP	2000	15	31.4	14	NO	PEL	NO	NO	NO	6,18
CHAETODONTIDAE	Chaetodon	sedentarius	TA	10039	18	52	87	NO	PEL	NO	NO	NO	PS*
CHAETODONTIDAE	Chaetodon	speculum	ICP	8700	18	44.7	27	NO	PEL	NO	NO	NO	2,PS
CHAETODONTIDAE	Chaetodon	striatus	TA	10477	20	49	52	NO	PEL	NO	YES	NO	PS*
CHAETODONTIDAE	Chaetodon	trifascialis	ICP	19500	18	35.7	28	NO	PEL	NO	NO	NO	2,PS
CHAETODONTIDAE	Chaetodon	ulietensis	ICP	11992	15	41	28	NO	PEL	NO	YES	NO	PS*
CHAETODONTIDAE	Chaetodon	unimaculatus	ICP	16986	20	35	59	NO	PEL	NO	NO	YES	2
CHAETODONTIDAE	Chaetodon	vagabundus	ICP	18323	23	42.26	30	NO	PEL	NO	YES	NO	19,PS
CHAETODONTIDAE	Chelmon	rostratus	ICP	7170	20	26.25	24	NO	PEL	NO	YES	NO	2,6
CHAETODONTIDAE	Forcipiger	flavissimus	ICP	27631	22	50.7	113	NO	PEL	NO	NO	YES	2
CHAETODONTIDAE	Heniochus	acuminatus	ICP	19500	25	40.83	73	NO	PEL	NO	NO	NO	3
CHAETODONTIDAE	Heniochus	chrysostomus	ICP	13455	18	32.7	38	NO	PEL	NO	YES	NO	PS*
CHAETODONTIDAE	Heniochus	diphreutes	ICP	16823	21	32	195	YES	PEL	NO	NO	NO	2
CIRRHITIDAE	Cirrhitichthys	oxycephalus	ICP	27631	10	51	39	NO	PEL	NO	YES	YES	2
CIRRHITIDAE	Neocirrhites	armatus	ICP	8033	9	48	9	NO	PEL	NO	NO	NO	2
CIRRHITIDAE	Oxycirrhites	typus	ICP	27891	13	69	90	NO	PEL	NO	NO	YES	2
CIRRHITIDAE	Paracirrhites	arcatus	ICP	20329	14	49.7	90	NO	PEL	NO	NO	NO	PS*
DACTYLOPTERIDAE	Dactyloptena	orientalis	ICP	20629	40	43.4	99	NO	PEL	YES	YES	NO	PS*

DACTYLOPTERIDAE	Dactylopterus	volitans	TA	12289	45	24	99	NO	PEL	YES	YES	NO	PS*
DACTYLOSCOPIDAE	Dactyloscopus	crossotus	TA	9501	7.5	19.7	8	NO	DEM	NO	NO	NO	PS*
DACTYLOSCOPIDAE	Gillellus	greyae	TA	8030	9.8	28.5	8	NO	DEM	NO	NO	NO	PS*
DACTYLOSCOPIDAE	Gillellus	uranidea	TA	2582	4.5	20.9	12	NO	DEM	NO	NO	NO	PS*
EPHIPPIDAE	Platax	pinnatus	ICP	7120	45	25	15	YES	PEL	NO	YES	NO	2
EPINEPHELIDAE	Cephalopholis	argus	ICP	19720	60	27.5	39	NO	PEL	NO	NO	NO	PS*
EPINEPHELIDAE	Cephalopholis	boenak	ICP	13862	26	31	63	NO	PEL	NO	YES	NO	PS*
EPINEPHELIDAE	Cephalopholis	urodeta	ICP	10242	27	24.3	59	NO	PEL	NO	NO	NO	PS*
EPINEPHELIDAE	Cromileptes	altivelis	ICP	8753	70	24	38	NO	PEL	NO	NO	NO	2
EPINEPHELIDAE	Epinephelus	adscensionis	TA	11294	62	40	119	NO	PEL	NO	NO	NO	10
EPINEPHELIDAE	Epinephelus	akaara	ICP	3300	30	30	50	NO	PEL	NO	NO	NO	PS*
EPINEPHELIDAE	Epinephelus	areolatus	ICP	16358	40	18	194	NO	PEL	NO	YES	NO	PS*
EPINEPHELIDAE	Epinephelus	corallicola	ICP	7869	49	41	25	NO	PEL	NO	YES	NO	3
EPINEPHELIDAE	Epinephelus	hexagonatus	ICP	21500	26	24.7	30	NO	PEL	NO	NO	NO	PS*
EPINEPHELIDAE	Epinephelus	itajara	TA	11294	250	55	95	NO	PEL	NO	YES	NO	50
EPINEPHELIDAE	Epinephelus	marginatus	TA	13077	150	24.6	292	NO	PEL	NO	NO	NO	7
EPINEPHELIDAE	Epinephelus	merra	ICP	19458	32	29.6	50	NO	PEL	NO	NO	NO	PS*
EPINEPHELIDAE	Epinephelus	striatus	TA	4199	100	42	89	NO	PEL	NO	YES	NO	51
EPINEPHELIDAE	Mycteroperca	bonaci	TA	8000	150	41	27	NO	PEL	NO	YES	NO	52
EPINEPHELIDAE	Mycteroperca	microlepis	TA	10000	145	43	112	NO	PEL	NO	YES	NO	52
EPINEPHELIDAE	Plectropomus	leopardus	ICP	9157	120	25.2	97	NO	PEL	NO	NO	NO	55
EPINEPHELIDAE	Plectropomus	maculatus	ICP	6305	125	27	95	NO	PEL	NO	YES	NO	39
FISTULARIIDAE	Fistularia	commersonii	ICP	27631	150	46	132	NO	PEL	NO	YES	YES	PS*
GOBIIDAE	Amblygobius	phalaena	ICP	13362	15	19.66	18	NO	DEM	NO	YES	NO	20
GOBIIDAE	Barbulifer	ceuthoecus	TA	9501	3	39.2	5	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Bathygobius	coalitus	ICP	19840	12	40	5	NO	DEM	NO	NO	NO	21
GOBIIDAE	Bathygobius	soporator	TA	11294	15	29	16	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Coryphopterus	glaucofraenum	TA	10477	8	25.26	43	NO	DEM	NO	YES	NO	22,PS
GOBIIDAE	Coryphopterus	kuna	TA	2790	2.2	61.35	15	NO	DEM	NO	YES	NO	23
GOBIIDAE	Elacatinus	evelynae	TA	2582	4	22.3	52	NO	DEM	NO	NO	NO	24
GOBIIDAE	Elacatinus	macrodon	TA	2967	5	28.7	7	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Elacatinus	oceanops	TA	1577	5	30	44	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Elacatinus	randalli	TA	970	4.6	38	60	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Eviota	melasma	ICP	9792	3.2	26.2	20	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Eviota	queenslandica	ICP	8666	3	24.2	19	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Eviota	sigillata	ICP	11312	2.5	24.7	17	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Gnatholepis	cauerensis	ICP	18549	5.3	39.8	48	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Gnatholepis	thompsoni	TA	12000	8.2	73	50	NO	DEM	NO	YES	NO	10,14,22,PS
GOBIIDAE	Gobiosoma	grosvenori	TA	3212	3	21.3	2	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Koumansetta	rainfordi	ICP	8000	8	33.76	28	NO	DEM	NO	YES	NO	6,20
GOBIIDAE	Lythrypnus	dalli	TEP	5148	6.4	58.3	76	NO	DEM	NO	NO	NO	25,26,27
GOBIIDAE	Microgobius	carri	TA	9026	7.5	33.3	15	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Nes	longus	TA	2967	10	29	23	NO	DEM	NO	YES	NO	PS*
GOBIIDAE	Paragobiodon	echinocephalus	ICP	19500	4	36	9	NO	DEM	NO	NO	NO	6
GOBIIDAE	Paragobiodon	lacunicolus	ICP	16770	3	31	20	NO	DEM	NO	NO	NO	6
GOBIIDAE	Paragobiodon	melanosomus	ICP	10354	3.5	42.3	14	NO	DEM	NO	NO	NO	6
GOBIIDAE	Priolepis	hipoliti	TA	3819	4	55.4	129	NO	DEM	NO	NO	NO	PS*
GOBIIDAE	Trimma	benjamini	ICP	7567	3	33.9	45	NO	DEM	NO	NO	NO	28
GOBIIDAE	Trimma	nasa	ICP	6880	2.8	33.9	41	NO	DEM	NO	NO	NO	29
HAEMULIDAE	Anisotremus	surinamensis	TA	10861	76	19.5	20	NO	PEL	NO	NO	NO	31,PS
HAEMULIDAE	Anisotremus	virginicus	TA	10861	40	16.95	18	YES	PEL	NO	NO	NO	31,PS
HAEMULIDAE	Haemulon	aurolineatum	TA	10861	25	19.3	30	YES	PEL	NO	YES	NO	PS*
HAEMULIDAE	Haemulon	chrysargyreum	TA	7595	23	22	25	YES	PEL	NO	YES	NO	PS*
HAEMULIDAE	Haemulon	flavolineatum	TA	4091	30	17	60	YES	PEL	NO	YES	NO	30,31
HAEMULIDAE	Haemulon	melanurum	TA	4199	35	18.4	47	YES	PEL	NO	YES	NO	PS*
HAEMULIDAE	Haemulon	parra	TA	10764	41	17.3	27	YES	PEL	NO	YES	NO	31,PS
HAEMULIDAE	Haemulon	plumierii	TA	10764	53	22.6	37	NO	PEL	NO	YES	NO	PS*

HAEMULIDAE	Haemulon	striatum	TA	9391	28	21.125	90	YES	PEL	NO	YES	NO	PS*
HOLOCENTRIDAE	Holocentrus	adscensionis	TA	11294	45	55.6	180	YES	PEL	YES	NO	NO	10,14,32
HOLOCENTRIDAE	Holocentrus	rufus	TA	9391	44	44.1	32	YES	PEL	YES	NO	NO	32
HOLOCENTRIDAE	Myripristis	jacobus	TA	11294	25	53.8	100	YES	PEL	YES	NO	NO	10,32
HOLOCENTRIDAE	Myripristis	pralinia	ICP	19840	20	67	42	NO	PEL	YES	NO	NO	PS*
HOLOCENTRIDAE	Neoniphon	argenteus	ICP	18549	19	41	37	NO	PEL	YES	NO	NO	PS*
HOLOCENTRIDAE	Neoniphon	marianus	TA	3819	22	39.3	69	NO	PEL	YES	NO	NO	32
HOLOCENTRIDAE	Neoniphon	sammara	ICP	19720	30	47	46	YES	PEL	YES	NO	NO	PS*
HOLOCENTRIDAE	Plectrypops	retrospinis	TA	10386	15	43.6	17	NO	PEL	YES	NO	NO	32
HOLOCENTRIDAE	Sargocentron	coruscum	TA	3819	13.5	35.5	29	NO	PEL	YES	NO	NO	32
HOLOCENTRIDAE	Sargocentron	microstoma	ICP	15099	19	40.3	182	NO	PEL	YES	NO	NO	PS*
HOLOCENTRIDAE	Sargocentron	punctatissimum	ICP	23259	13	45	183	NO	PEL	YES	YES	NO	PS*
HOLOCENTRIDAE	Sargocentron	spiniferum	ICP	21500	45	39.8	121	NO	PEL	YES	NO	NO	PS*
HOLOCENTRIDAE	Sargocentron	vexillarium	TA	3819	17.2	35.9	19	NO	PEL	YES	NO	NO	32
LABRIDAE	Anampses	caeruleopunctatus	ICP	23400	42	25	27	NO	PEL	NO	NO	NO	2
LABRIDAE	Anampses	chrysocephalus	ICP	2100	17	29.5	127	NO	PEL	NO	NO	NO	33
LABRIDAE	Anampses	cuvier	ICP	2100	31	44.5	24	NO	PEL	NO	NO	NO	33
LABRIDAE	Anampses	twistii	ICP	20000	18	28.8	25	NO	PEL	NO	NO	NO	33
LABRIDAE	Bodianus	axillaris	ICP	21325	20	23.5	98	NO	PEL	NO	NO	NO	33
LABRIDAE	Bodianus	bilunulatus	ICP	19375	55	66.8	152	NO	PEL	NO	NO	NO	33
LABRIDAE	Bodianus	diplotaenia	TEP	7363	76	39.85	71	NO	PEL	NO	YES	NO	33,34
LABRIDAE	Bodianus	eclancheri	TEP	3860	60	32.3	41	NO	PEL	NO	NO	NO	34
LABRIDAE	Bodianus	mesothorax	ICP	4977	25	30.3	35	NO	PEL	NO	NO	NO	33
LABRIDAE	Bodianus	perditio	ICP	20329	80	59.6	140	NO	PEL	NO	NO	NO	PS*
LABRIDAE	Bodianus	rufus	TA	10861	50	36.6	69	NO	PEL	NO	NO	NO	33
LABRIDAE	Bolbometopon	muricatum	ICP	21680	130	31	29	YES	PEL	NO	NO	NO	2
LABRIDAE	Cheilinus	chlorourus	ICP	19580	36	27.1	29	NO	PEL	NO	NO	NO	33
LABRIDAE	Cheilinus	fasciatus	ICP	17000	36	25.7	56	NO	PEL	NO	YES	NO	33
LABRIDAE	Cheilinus	trilobatus	ICP	19000	40	29.6	29	NO	PEL	NO	YES	NO	33
LABRIDAE	Cheilinus	undulatus	ICP	21325	229	34.3	99	NO	PEL	NO	YES	NO	33
LABRIDAE	Cheilio	inermis	ICP	23400	50	56.1	29	NO	PEL	NO	YES	NO	33
LABRIDAE	Choerodon	anchorago	ICP	8700	38	19.3	24	NO	PEL	NO	YES	NO	33
LABRIDAE	Choerodon	fasciatus	ICP	6908	30	20	30	NO	PEL	NO	NO	NO	2
LABRIDAE	Choerodon	graphicus	ICP	1876	46	27	29	NO	PEL	NO	YES	NO	PS*
LABRIDAE	Cirrhilabrus	cyanopleura	ICP	6235	10	25.55	28	NO	PEL	NO	NO	NO	2,33
LABRIDAE	Cirrhilabrus	scottorum	ICP	8369	13	27	37	NO	PEL	NO	NO	NO	PS*
LABRIDAE	Cirrhilabrus	temminkii	ICP	4980	10	27.3	32	NO	PEL	NO	NO	NO	2,6
LABRIDAE	Clepticus	parrae	TA	4199	30	38.5	39	YES	PEL	NO	NO	NO	33
LABRIDAE	Coris	aygula	ICP	20158	120	51.5	28	NO	PEL	NO	YES	NO	2,3
LABRIDAE	Coris	batuensis	ICP	14574	17	27.55	30	NO	PEL	NO	YES	NO	2,6,33
LABRIDAE	Coris	flavovittata	ICP	2100	50.8	53	97	NO	PEL	NO	YES	NO	33
LABRIDAE	Coris	gaimard	ICP	11600	40	45.76	49	NO	PEL	NO	YES	NO	2,33
LABRIDAE	Coris	picta	ICP	3148	25	46.2	22	NO	PEL	NO	YES	NO	PS*
LABRIDAE	Coris	venusta	ICP	2100	19.3	46.1	8	NO	PEL	NO	YES	NO	33
LABRIDAE	Cymolutes	lecluse	ICP	2100	17.8	75.9	118	NO	PEL	NO	YES	NO	33
LABRIDAE	Cymolutes	praetextatus	ICP	17970	20	71	5	NO	PEL	NO	NO	NO	33
LABRIDAE	Diproctacanthus	xanthurus	ICP	5400	8	17.3	18	NO	PEL	NO	NO	NO	33
LABRIDAE	Doratonotus	megalepis	TA	11433	9.4	21.9	14	NO	PEL	NO	YES	NO	33
LABRIDAE	Epibulus	insidiator	ICP	20000	54	30.4	41	NO	PEL	NO	NO	NO	33
LABRIDAE	Gomphosus	varius	ICP	11600	30	56.6	28	NO	PEL	NO	NO	NO	2,33
LABRIDAE	Halichoeres	adustus	TEP	3000	12.5	33	2	NO	PEL	NO	NO	NO	34
LABRIDAE	Halichoeres	argus	ICP	11258	12	25	10	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	biocellatus	ICP	7959	12	24.26	28	NO	PEL	NO	YES	NO	2,33
LABRIDAE	Halichoeres	bivittatus	TA	9391	22	22.3	14	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Halichoeres	chierchiae	TEP	4530	17.5	31.3	67	NO	PEL	NO	YES	NO	33,34
LABRIDAE	Halichoeres	chloropterus	ICP	6200	19	21.1	10	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	chrysus	ICP	6160	12	26.1	58	NO	PEL	NO	YES	NO	33

LABRIDAE	Halichoeres	discolor	TEP	10	15	32	26	NO	PEL	NO	NO	NO	34
LABRIDAE	Halichoeres	dispilus	TEP	5675	25	40.25	74	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	garnoti	TA	3819	30	24.9	78	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Halichoeres	hortulanus	ICP	20600	27	32.5	29	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	insularis	TEP	30	7	35.5	3	NO	PEL	NO	YES	NO	34
LABRIDAE	Halichoeres	maculipinna	TA	3819	15	29.5	22	NO	PEL	NO	YES	NO	3,33,PS
LABRIDAE	Halichoeres	margaritaceus	ICP	13400	12.5	21.7	5	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	marginatus	ICP	20600	18	22.2	30	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	melanotis	TEP	4530	15	35.7	29	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	melanurus	ICP	8957	12	24.53	24	NO	PEL	NO	NO	NO	6,33
LABRIDAE	Halichoeres	nebulosus	ICP	13040	12	23.9	39	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	nicholsi	TEP	4530	38	31.4	50	NO	PEL	NO	YES	NO	33,34
LABRIDAE	Halichoeres	notospilus	TEP	5675	25	37.7	10	NO	PEL	NO	YES	NO	33,34
LABRIDAE	Halichoeres	ornatissimus	ICP	11600	18	39.5	11	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	pictus	TA	4091	13	24.9	20	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	poeyi	TA	10764	20	24.1	14	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	prosopeion	ICP	8957	13	21.2	38	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	radiatus	TA	8198	51	24.55	53	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Halichoeres	richmondi	ICP	7380	19	20.8	28	NO	PEL	NO	NO	NO	33
LABRIDAE	Halichoeres	scapularis	ICP	14900	20	24.4	8	NO	PEL	NO	YES	NO	33
LABRIDAE	Halichoeres	semicintus	TEP	1342	38	29.9	22	NO	PEL	NO	YES	NO	34
LABRIDAE	Halichoeres	trimaculatus	ICP	10700	27	26.8	28	NO	PEL	NO	YES	NO	33
LABRIDAE	Hemigymnus	fasciatus	ICP	20600	80	25.8	19	NO	PEL	NO	NO	NO	33
LABRIDAE	Hemigymnus	melapterus	ICP	19500	90	23.9	29	NO	PEL	NO	NO	NO	33
LABRIDAE	Iniistius	pavo	ICP	27891	41	60.16	99	NO	PEL	NO	YES	YES	33
LABRIDAE	Labrichthys	unilineatus	ICP	15926	17.5	19.2	20	NO	PEL	NO	NO	NO	33
LABRIDAE	Labroides	bicolor	ICP	17970	15	24.25	38	NO	PEL	NO	NO	NO	2,33
LABRIDAE	Labroides	dimidiatus	ICP	17970	14	23.16	39	NO	PEL	NO	NO	NO	2,33
LABRIDAE	Labroides	pectoralis	ICP	10700	11	26.8	26	NO	PEL	NO	NO	NO	33
LABRIDAE	Labroides	phthirophagus	ICP	2100	12	32.1	90	NO	PEL	NO	NO	NO	33
LABRIDAE	Labropsis	micronesica	ICP	3957	12	22	26	NO	PEL	NO	NO	NO	33
LABRIDAE	Labropsis	xanthonota	ICP	15924	13	30.5	48	NO	PEL	NO	NO	NO	33
LABRIDAE	Lachnolaimus	maximus	TA	4091	91	25.8	27	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Macropharyngodon	geoffroy	ICP	9500	15	32.3	26	NO	PEL	NO	YES	NO	33
LABRIDAE	Macropharyngodon	meleagris	ICP	13454	15	27.5	30	NO	PEL	NO	YES	NO	2,33
LABRIDAE	Macropharyngodon	negrosensis	ICP	10430	12	25	24	NO	PEL	NO	YES	NO	33
LABRIDAE	Novaculichthys	macrolepidotus	ICP	13040	15	70.5	4	NO	PEL	NO	YES	NO	33
LABRIDAE	Novaculichthys	taeniourus	ICP	27631	30	55.1	22	NO	PEL	NO	YES	YES	2,33,34,PS
LABRIDAE	Oxycheilinus	bimaculatus	ICP	19580	15	50.5	108	NO	PEL	NO	YES	NO	33
LABRIDAE	Oxycheilinus	digramma	ICP	14920	30	26.1	47	NO	PEL	NO	NO	NO	33
LABRIDAE	Oxycheilinus	unifasciatus	ICP	12500	46	36.2	159	NO	PEL	NO	NO	NO	33
LABRIDAE	Pseudocheilinus	evanidus	ICP	19500	8	42.5	55	NO	PEL	NO	NO	NO	33
LABRIDAE	Pseudocheilinus	hexataenia	ICP	19500	10	35	33	NO	PEL	NO	NO	NO	33
LABRIDAE	Pseudocheilinus	octotaenia	ICP	18323	14	41.6	48	NO	PEL	NO	NO	NO	33
LABRIDAE	Pseudocheilinus	tetrataenia	ICP	8842	7.5	49.3	38	NO	PEL	NO	NO	NO	33
LABRIDAE	Pseudojuloides	cerasinus	ICP	18323	12.3	42.4	59	NO	PEL	NO	NO	NO	33
LABRIDAE	Pteragogus	cryptus	ICP	17000	9.5	20.6	65	NO	PEL	NO	NO	NO	33
LABRIDAE	Pteragogus	flagellifer	ICP	11900	20	23	23	NO	PEL	NO	NO	NO	33
LABRIDAE	Pteragogus	guttatus	ICP	5881	9	20.5	23	NO	PEL	NO	NO	NO	33
LABRIDAE	Scarus	coeruleus	TA	3800	120	24	22	NO	PEL	NO	YES	NO	PS*
LABRIDAE	Scarus	ghobban	ICP	27631	75	29.7	33	NO	PEL	NO	YES	YES	PS*
LABRIDAE	Scarus	iseri	TA	4199	27	28.4	22	YES	PEL	NO	YES	NO	PS*
LABRIDAE	Scarus	rivulatus	ICP	8639	40	37	38	YES	PEL	NO	NO	NO	4
LABRIDAE	Scarus	schlegeli	ICP	11151	38	30.4	49	YES	PEL	NO	NO	NO	PS*
LABRIDAE	Scarus	taeniopterus	TA	4091	35	28.2	23	NO	PEL	NO	NO	NO	35
LABRIDAE	Semicossyphus	darwini	TEP	2000	70	37	97	NO	PEL	NO	NO	NO	34
LABRIDAE	Semicossyphus	pulcher	TEP	1893	90	37.4	55	NO	PEL	NO	YES	NO	34

LABRIDAE	Sparisoma	atomarium	TA	4199	15	18	35	NO	PEL	NO	YES	NO	PS*
LABRIDAE	Sparisoma	aurofrenatum	TA	4199	28	48.6	18	NO	PEL	NO	YES	NO	PS*
LABRIDAE	Sparisoma	viride	TA	4199	64	48.3	47	NO	PEL	NO	NO	NO	PS*
LABRIDAE	Stethojulis	balteata	ICP	2100	15	38.5	13	NO	PEL	NO	NO	NO	2,33
LABRIDAE	Stethojulis	bandanensis	ICP	20210	15	30.7	27	NO	PEL	NO	YES	YES	33,34
LABRIDAE	Stethojulis	notialis	ICP	1700	10	40.3	6	NO	PEL	NO	NO	NO	PS*
LABRIDAE	Stethojulis	strigiventer	ICP	17970	15	23.4	13	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	amblycephalum	ICP	16164	16	72.4	14	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	ballieui	ICP	2100	39.5	84	59	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	bifasciatum	TA	4091	15	48.2	40	NO	PEL	NO	YES	NO	3,33,PS
LABRIDAE	Thalassoma	duperrey	ICP	2100	28	89.2	19	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	grammaticum	TEP	4530	32	61.8	39	NO	PEL	NO	NO	NO	34
LABRIDAE	Thalassoma	hardwicke	ICP	17970	20	54.5	15	NO	PEL	NO	NO	NO	2,33,PS
LABRIDAE	Thalassoma	jansenii	ICP	8801	20	63.3	14	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	lucasanum	TEP	4093	15	72.25	64	NO	PEL	NO	NO	NO	33,34
LABRIDAE	Thalassoma	lunare	ICP	20600	45	50.12	19	NO	PEL	NO	NO	NO	2,3,6,33
LABRIDAE	Thalassoma	lutescens	ICP	17970	30	78	29	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	purpureum	ICP	27631	46	57.7	10	NO	PEL	NO	NO	YES	34
LABRIDAE	Thalassoma	quinquevittatum	ICP	17970	17	56.4	40	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	robertsoni	TEP	7	7.8	58.6	47	NO	PEL	NO	NO	NO	34
LABRIDAE	Thalassoma	trilobatum	ICP	19375	30	78.3	10	NO	PEL	NO	NO	NO	33
LABRIDAE	Thalassoma	virens	TEP	1023	30	68.8	10	NO	PEL	NO	NO	NO	34
LABRIDAE	Xyrichtys	martinicensis	TA	10386	15	54.15	19	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Xyrichtys	mundiceps	TEP	4530	14.5	59.2	3	NO	PEL	NO	YES	NO	34
LABRIDAE	Xyrichtys	novacula	TA	9258	38	39	89	NO	PEL	NO	YES	NO	7,33,PS
LABRIDAE	Xyrichtys	splendens	TA	9790	17.5	72.1	12	NO	PEL	NO	YES	NO	33,PS
LABRIDAE	Xyrichtys	victori	TEP	400	15	73.7	20	NO	PEL	NO	YES	NO	34
LABRIDAE	Xyrichtys	wellingtoni	TEP	7	7.2	68	2	NO	PEL	NO	YES	NO	34
LABRISOMIDAE	Labrisomus	nuchipinnis	TA	11294	22	25	10	NO	DEM	NO	YES	NO	PS*
LABRISOMIDAE	Malacoctenus	hubbsi	TEP	1410	9	24	3	NO	DEM	NO	NO	NO	12
LABRISOMIDAE	Malacoctenus	macropus	TA	2967	5.2	21.375	8	NO	DEM	NO	YES	NO	PS*
LABRISOMIDAE	Paraclinus	nigripinnis	TA	2967	5	18.75	10	NO	DEM	NO	YES	NO	PS*
LABRISOMIDAE	Starksia	ocellata	TA	2806	6	19	18	NO	DEM	NO	NO	NO	PS*
LETHRINIDAE	Gnathodentex	aureolineatus	ICP	20329	30	40	27	YES	PEL	YES	YES	NO	PS*
LETHRINIDAE	Lethrinus	atkinsoni	ICP	12157	40	26.6	23	NO	PEL	YES	YES	NO	9
LETHRINIDAE	Lethrinus	genivittatus	ICP	7290	25	29.05	20	NO	PEL	NO	YES	NO	9,PS
LETHRINIDAE	Lethrinus	harak	ICP	17390	50	28	18	NO	PEL	NO	YES	NO	9
LETHRINIDAE	Lethrinus	nebulosus	ICP	17000	86	32.7	65	YES	PEL	YES	YES	NO	6,9
LETHRINIDAE	Lethrinus	obsoletus	ICP	17390	50	25.7	28	NO	PEL	YES	YES	NO	9
LETHRINIDAE	Lethrinus	olivaceus	ICP	17390	100	30	184	NO	PEL	NO	YES	NO	9
LETHRINIDAE	Lethrinus	ornatus	ICP	7884	40	26.6	29	NO	PEL	YES	YES	NO	9
LETHRINIDAE	Lethrinus	variegatus	ICP	15033	20	32	149	YES	PEL	NO	YES	NO	PS*
LETHRINIDAE	Lethrinus	xanthochilus	ICP	19500	70	26.65	149	NO	PEL	NO	YES	NO	3
LETHRINIDAE	Monotaxis	grandoculis	ICP	20629	60	33.3	99	NO	PEL	YES	YES	NO	PS*
LUTJANIDAE	Hoplopagrus	guentherii	TEP	4497	92	21.5	50	NO	PEL	NO	YES	NO	36
LUTJANIDAE	Lutjanus	analis	TA	10861	94	31	70	NO	PEL	NO	YES	NO	31
LUTJANIDAE	Lutjanus	apodus	TA	4199	67	32	61	YES	PEL	NO	YES	NO	31
LUTJANIDAE	Lutjanus	argentiventris	TEP	7500	71	22.9	57	NO	PEL	NO	YES	NO	37
LUTJANIDAE	Lutjanus	buccanella	TA	10002	75	26	180	NO	PEL	NO	YES	NO	PS*
LUTJANIDAE	Lutjanus	campechanus	TA	2876	100	28	180	NO	PEL	NO	YES	NO	38
LUTJANIDAE	Lutjanus	carponotatus	ICP	7884	40	35	78	YES	PEL	NO	NO	NO	39
LUTJANIDAE	Lutjanus	cyanopterus	TA	10861	160	29	78	NO	PEL	NO	YES	NO	40
LUTJANIDAE	Lutjanus	decussatus	ICP	7884	30	32.3	30	NO	PEL	NO	NO	NO	9
LUTJANIDAE	Lutjanus	fulviflamma	ICP	17000	35	23.26	32	YES	PEL	NO	YES	NO	3,9
LUTJANIDAE	Lutjanus	fulvus	ICP	19840	40	27.7	74	NO	PEL	NO	YES	NO	PS*
LUTJANIDAE	Lutjanus	gibbus	ICP	19500	50	54	149	YES	PEL	NO	YES	NO	3
LUTJANIDAE	Lutjanus	griseus	TA	4199	66	32.4	175	YES	PEL	NO	YES	NO	31,41

LUTJANIDAE	Lutjanus	guttatus	TEP	7175	80	24.15	29	YES	PEL	NO	YES	NO	36
LUTJANIDAE	Lutjanus	kasmira	ICP	19500	40	31	262	YES	PEL	NO	YES	NO	PS*
LUTJANIDAE	Lutjanus	novemfasciatus	TEP	5397	170	21.75	59	NO	PEL	NO	YES	NO	36
LUTJANIDAE	Lutjanus	sebae	ICP	13040	100	40	175	NO	PEL	NO	YES	NO	2
LUTJANIDAE	Lutjanus	synagris	TA	10861	71	23.87	390	YES	PEL	NO	YES	NO	31,PS
LUTJANIDAE	Lutjanus	viridis	TEP	5189	30	37.9	27	YES	PEL	NO	YES	NO	36
LUTJANIDAE	Lutjanus	vitta	ICP	9979	40	31.3	62	YES	PEL	NO	NO	NO	PS*
LUTJANIDAE	Ocyurus	chrysurus	TA	10861	86	30.9	180	YES	PEL	NO	YES	NO	31,PS
LUTJANIDAE	Pristipomoides	filamentosus	ICP	19458	100	45	360	NO	PEL	NO	NO	NO	14
MALACANTHIDAE	Hoplolatilus	purpureus	ICP	4848	12	34	62	NO	PEL	NO	YES	NO	2
MONACANTHIDAE	Acreichthys	tomentosus	ICP	9979	11.5	23.9	13	NO	PEL	NO	YES	NO	PS*
MONACANTHIDAE	Monacanthus	chinensis	ICP	8957	38	20	9	NO	PEL	NO	YES	NO	6
MONACANTHIDAE	Monacanthus	tuckeri	TA	4199	9	41.9	48	NO	PEL	NO	YES	NO	42
MONACANTHIDAE	Paraluteres	prionurus	ICP	13330	11	28	24	NO	PEL	NO	NO	NO	6
MULLIDAE	Mulloidichthys	flavolineatus	ICP	21500	40	60.1	30	YES	PEL	NO	YES	NO	PS*
MULLIDAE	Mulloidichthys	vanicolensis	ICP	27631	38	36.3	108	YES	PEL	NO	YES	YES	PS*
MULLIDAE	Parupeneus	barbarinoides	ICP	9792	25	42.3	14	NO	PEL	NO	YES	NO	9
MULLIDAE	Parupeneus	barberinus	ICP	18470	60	38.6	99	NO	PEL	NO	YES	NO	3,PS
MULLIDAE	Parupeneus	indicus	ICP	16219	35	33	112	YES	PEL	NO	YES	NO	9
MULLIDAE	Parupeneus	multifasciatus	ICP	11600	35	45	139	NO	PEL	NO	YES	NO	3,PS
MULLIDAE	Parupeneus	pleurostigma	ICP	19375	33	50	37	NO	PEL	NO	YES	NO	3,PS
MULLIDAE	Upeneus	tragula	ICP	15033	33	31.1	24	YES	PEL	NO	YES	NO	43
MURAENIDAE	Echidna	nebulosa	ICP	27631	75	80	47	NO	PEL	YES	NO	YES	2
MURAENIDAE	Rhinomuraena	quaesita	ICP	18566	130	71	56	NO	PEL	YES	YES	NO	2
NEMIPTERIDAE	Scolopsis	bilineata	ICP	11737	25	25	24	NO	PEL	NO	NO	NO	PS*
NEMIPTERIDAE	Scolopsis	taenioptera	ICP	7100	30	19	49	NO	PEL	NO	YES	NO	6
OPISTOGNATHIDAE	Opistognathus	whitehursti	TA	9294	7.8	26.5	11	NO	DEM	YES	YES	NO	PS*
OSTRACIIDAE	Lactoria	cornuta	ICP	20629	46	58	82	NO	PEL	NO	YES	NO	PS*
OSTRACIIDAE	Ostracion	cubicus	ICP	20629	15	44.3	279	NO	PEL	NO	NO	NO	PS*
OSTRACIIDAE	Ostracion	meleagris	ICP	27631	25	61.5	29	NO	PEL	NO	NO	YES	2
PINGUIPEDIDAE	Parapercis	australis	ICP	3891	9.2	41.6	3	NO	PEL	NO	NO	NO	PS*
POMACANTHIDAE	Apolemichthys	trimaculatus	ICP	15924	26	24.2	37	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	acanthops	ICP	4186	8	34	34	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	argi	TA	4199	8	36.8	75	NO	PEL	NO	YES	NO	45
POMACANTHIDAE	Centropyge	bicolor	ICP	8957	15	32	24	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	bispinosa	ICP	17970	10	32	36	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	eibli	ICP	5216	15	25.3	20	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	ferrugata	ICP	1983	10	38	24	NO	PEL	NO	YES	NO	44
POMACANTHIDAE	Centropyge	fisheri	ICP	19458	7.5	38.33	85	NO	PEL	NO	YES	NO	44
POMACANTHIDAE	Centropyge	flavissima	ICP	11915	14	30.3	47	NO	PEL	NO	NO	NO	44,PS
POMACANTHIDAE	Centropyge	heraldi	ICP	10000	10	32	85	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	interruptus	ICP	7846	15	31.5	48	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	loricula	ICP	7958	15	38	45	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	multifasciata	ICP	11939	12	26.2	63	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	nox	ICP	6849	10	31.5	67	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	potteri	ICP	2100	10	35.5	133	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	tibicen	ICP	6773	19	30	51	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	venusta	ICP	2600	12	25	30	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Centropyge	vroliki	ICP	6944	12	29	22	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Chaetodontoplus	duboulayi	ICP	2600	28	21.64	19	NO	PEL	NO	YES	NO	44
POMACANTHIDAE	Chaetodontoplus	melanosoma	ICP	4356	20	22.2	20	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Chaetodontoplus	mesoleucus	ICP	7468	18	19.9	19	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Chaetodontoplus	personifer	ICP	2863	35	23.2	29	NO	PEL	NO	YES	NO	44
POMACANTHIDAE	Chaetodontoplus	septentrionalis	ICP	2557	22	23	10	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Genicanthus	bellus	ICP	10600	18	25	76	YES	PEL	NO	NO	NO	44
POMACANTHIDAE	Genicanthus	melanospilos	ICP	8967	18	25	25	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Holacanthus	bermudensis	TA	3273	45	22.7	90	NO	PEL	NO	NO	NO	45,PS

POMACANTHIDAE	Holacanthus	ciliaris	TA	10861	45	22.4	69	NO	PEL	NO	NO	NO	45
POMACANTHIDAE	Holacanthus	tricolor	TA	10861	25	29.7	89	NO	PEL	NO	NO	NO	45
POMACANTHIDAE	Pomacanthus	annularis	ICP	13242	45	21	28	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pomacanthus	arcuatus	TA	10861	60	19.9	28	NO	PEL	NO	YES	NO	45,PS
POMACANTHIDAE	Pomacanthus	imperator	ICP	19500	40	22	99	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pomacanthus	navarchus	ICP	6500	25	22.83	37	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pomacanthus	paru	TA	10861	40	17.7	97	NO	PEL	NO	YES	NO	45
POMACANTHIDAE	Pomacanthus	semicirculatus	ICP	14920	40	19.5	29	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pomacanthus	sexstriatus	ICP	7656	46	18	47	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pomacanthus	xanthometopon	ICP	10869	38	20.38	20	NO	PEL	NO	NO	NO	44
POMACANTHIDAE	Pygoplites	diacanthus	ICP	19500	25	24.5	47	NO	PEL	NO	NO	NO	44
POMACENTRIDAE	Abudefduf	abdominalis	ICP	5625	30	20.85	49	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Abudefduf	bengalensis	ICP	10500	17	22.8	5	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Abudefduf	concolor	TEP	3000	19	20.85	12	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Abudefduf	declivifrons	TEP	2000	18	21.9	4	NO	DEM	NO	NO	NO	34
POMACENTRIDAE	Abudefduf	lorenzi	ICP	5500	18	23	5	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Abudefduf	saxatilis	TA	11294	23	23.5	20	YES	DEM	NO	NO	NO	47,PS
POMACENTRIDAE	Abudefduf	sexfasciatus	ICP	20000	19	19.4	19	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Abudefduf	sordidus	ICP	20000	23	26.1	3	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Abudefduf	taurus	TA	11294	25	24.45	4	NO	DEM	NO	NO	NO	45,47
POMACENTRIDAE	Abudefduf	troschelii	TEP	6000	18	18.1	11	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Abudefduf	vaigiensis	ICP	19500	15	21.13	14	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Abudefduf	whitleyi	ICP	2800	19	18.3	4	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Acanthochromis	polyacanthus	ICP	5718	14	1	64	YES	DEM	NO	NO	NO	15,46
POMACENTRIDAE	Amblyglyphidodon	aureus	ICP	8600	13	16.5	42	NO	DEM	NO	NO	NO	20,47
POMACENTRIDAE	Amblyglyphidodon	curacao	ICP	7400	11	15.68	39	NO	DEM	NO	NO	NO	20,46,47
POMACENTRIDAE	Amblyglyphidodon	leucogaster	ICP	10450	13	16.35	43	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Amblyglyphidodon	ternatensis	ICP	5500	10	20	14	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Amphiprion	akindynos	ICP	2770	9	12.4	24	NO	DEM	NO	NO	NO	20,46
POMACENTRIDAE	Amphiprion	chrysopterus	ICP	8900	17	17	29	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Amphiprion	clarkii	ICP	14268	15	12.15	59	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Amphiprion	melanopus	ICP	10275	12	12.4	17	NO	DEM	NO	NO	NO	5,15,20,46,47,48
POMACENTRIDAE	Amphiprion	percula	ICP	2600	11	10.8	14	NO	DEM	NO	NO	NO	19,46
POMACENTRIDAE	Amphiprion	perideraion	ICP	7220	10	14.3	37	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Amphiprion	polymnus	ICP	6200	13	11	28	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Amphiprion	tricinctus	ICP	1200	12	10.1	37	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Cheiloprion	labiatus	ICP	7900	6	16.5	2	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	agilis	ICP	19375	8	32.7	62	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	alpha	ICP	11600	8	30	83	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	alta	TEP	4150	13	18.7	120	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	amboinensis	ICP	6167	9	22.1	65	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Chromis	atrilobata	TEP	6000	12	30.95	74	YES	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Chromis	atripectoralis	ICP	19000	12	19	28	YES	DEM	NO	NO	NO	2,15,20,46,PS
POMACENTRIDAE	Chromis	atripes	ICP	7400	9	30	38	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	caerulea	ICP	19458	6.5	26	11	YES	DEM	NO	NO	NO	2
POMACENTRIDAE	Chromis	caudalis	ICP	10680	8	27	40	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	chrysura	ICP	12300	14	23.2	39	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Chromis	cyanea	TA	4199	15	29.9	57	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	delta	ICP	7959	7	24	70	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	hanui	ICP	2100	6	27	44	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	insolata	TA	4199	16	25.75	80	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	iomelas	ICP	3890	8	24.4	32	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Chromis	lepidolepis	ICP	20600	9	31.5	41	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	limbaughi	TEP	1000	10	23.5	71	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Chromis	lineata	ICP	20600	7	33.75	33	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	margaritifer	ICP	12196	9	31.8	18	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	multilineata	TA	11294	20	28.16	60	YES	DEM	NO	NO	NO	2,47

POMACENTRIDAE	Chromis	notata	ICP	1948	17	40	13	NO	DEM	NO	NO	NO	16
POMACENTRIDAE	Chromis	retrofasciata	ICP	5330	4	21.45	62	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	ternatensis	ICP	15850	10	28.5	34	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	vanderbilti	ICP	10115	4.5	33.55	18	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Chromis	viridis	ICP	20000	8	23.97	2	YES	DEM	NO	NO	NO	2,20,46,47
POMACENTRIDAE	Chromis	weberi	ICP	21650	14	31.2	37	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chromis	xanthura	ICP	13467	15	28.2	37	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Chrysiptera	biocellata	ICP	15924	12	18.4	5	NO	DEM	NO	NO	NO	2,46,47
POMACENTRIDAE	Chrysiptera	brownriggii	ICP	17480	8	22.13	12	NO	DEM	NO	NO	NO	46,47,PS
POMACENTRIDAE	Chrysiptera	cyanea	ICP	7330	8	17.43	10	NO	DEM	NO	NO	NO	2,46,47
POMACENTRIDAE	Chrysiptera	flavipinnis	ICP	2300	8	19	35	NO	DEM	NO	YES	NO	46
POMACENTRIDAE	Chrysiptera	galba	ICP	3068	7	23.5	29	NO	DEM	NO	NO	NO	PS*
POMACENTRIDAE	Chrysiptera	glauca	ICP	19960	10	23.5	3	YES	DEM	NO	YES	NO	46,PS
POMACENTRIDAE	Chrysiptera	hemicyanea	ICP	2740	7	19.3	37	NO	DEM	NO	NO	NO	2,46
POMACENTRIDAE	Chrysiptera	oxycephala	ICP	5023	9	21.5	15	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chrysiptera	rex	ICP	6200	7	19.78	19	NO	DEM	NO	NO	NO	2,20,46,47
POMACENTRIDAE	Chrysiptera	rollandi	ICP	7470	8	19.76	33	NO	DEM	NO	NO	NO	2,6,20,46,47
POMACENTRIDAE	Chrysiptera	talboti	ICP	9900	6	22	32	NO	DEM	NO	NO	NO	6
POMACENTRIDAE	Chrysiptera	traceyi	ICP	4500	4	23	35	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Chrysiptera	tricincta	ICP	7876	6	19.4	28	NO	DEM	NO	YES	NO	9
POMACENTRIDAE	Dascyllus	albisella	ICP	2100	13	25.9	49	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Dascyllus	aruanus	ICP	19500	10	21.1	20	YES	DEM	NO	NO	NO	6,46,47,PS
POMACENTRIDAE	Dascyllus	flavicaudus	ICP	2208	11	27.7	37	YES	DEM	NO	NO	NO	PS*
POMACENTRIDAE	Dascyllus	melanurus	ICP	3850	8	22.25	67	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Dascyllus	reticulatus	ICP	11350	9	22.7	49	YES	DEM	NO	NO	NO	2,46,47
POMACENTRIDAE	Dascyllus	trimaculatus	ICP	18700	11	28	54	YES	DEM	NO	NO	NO	46,47,PS
POMACENTRIDAE	Dischistodus	chrysopoecilus	ICP	6200	15	19.5	4	NO	DEM	NO	YES	NO	47
POMACENTRIDAE	Dischistodus	melanotus	ICP	6200	16	14.85	11	NO	DEM	NO	YES	NO	46,47
POMACENTRIDAE	Dischistodus	perspicillatus	ICP	8600	18	14.9	9	NO	DEM	NO	YES	NO	46,47
POMACENTRIDAE	Dischistodus	prosopotaenia	ICP	6814	18.5	23.5	11	NO	DEM	NO	YES	NO	9
POMACENTRIDAE	Dischistodus	pseudochrysopoecilus	ICP	7420	18	17.6	4	NO	DEM	NO	YES	NO	6,46,47
POMACENTRIDAE	Hemiglyphidodon	plagiometopon	ICP	7170	18	18	19	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Lepidozygus	tapeinosoma	ICP	17800	10	19.35	29	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Microspathodon	bairdii	TEP	5148	30	25.9	5	NO	DEM	NO	NO	NO	34
POMACENTRIDAE	Microspathodon	chrysurus	TA	9391	21	25.85	120	NO	DEM	NO	NO	NO	45,47
POMACENTRIDAE	Microspathodon	dorsalis	TEP	5148	31	31.45	4	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Neoglyphidodon	melas	ICP	14930	18	15.45	11	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Neoglyphidodon	nigroris	ICP	8480	13	18.8	21	NO	DEM	NO	NO	NO	6,46,47
POMACENTRIDAE	Neopomacentrus	azysron	ICP	14500	8	22	11	YES	DEM	NO	NO	NO	6,46
POMACENTRIDAE	Neopomacentrus	bankieri	ICP	5574	6.5	21	9	YES	DEM	NO	NO	NO	5
POMACENTRIDAE	Neopomacentrus	cyanomos	ICP	14800	10	17.5	25	YES	DEM	NO	NO	NO	46
POMACENTRIDAE	Neopomacentrus	filamentosus	ICP	7170	11	20	7	NO	DEM	NO	YES	NO	46
POMACENTRIDAE	Neopomacentrus	nemurus	ICP	5980	8	19.2	9	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Nexilosus	latifrons	TEP	2964	30	29.2	9	NO	DEM	NO	NO	NO	34
POMACENTRIDAE	Plectroglyphidodon	dickii	ICP	17127	11	26.6	14	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Plectroglyphidodon	imparipennis	ICP	17480	6	29.7	6	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Plectroglyphidodon	johnstonianus	ICP	19960	14	31.7	17	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Plectroglyphidodon	lacrymatus	ICP	17127	10	22.35	39	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Plectroglyphidodon	sindonis	ICP	2100	10	30	3	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	alexanderae	ICP	4300	9	20.65	55	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	amboinensis	ICP	8400	9	20.14	38	YES	DEM	NO	YES	NO	2,5,6,20,46,47
POMACENTRIDAE	Pomacentrus	australis	ICP	1498	8	25	30	NO	DEM	NO	YES	NO	46
POMACENTRIDAE	Pomacentrus	bankanensis	ICP	9770	9	18.4	12	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Pomacentrus	brachialis	ICP	8000	8	18	34	YES	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Pomacentrus	burroughi	ICP	6200	8	16.8	14	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	chrysurus	ICP	10390	9	17	3	NO	DEM	NO	YES	NO	46,47
POMACENTRIDAE	Pomacentrus	coelestis	ICP	14320	9	17.82	19	YES	DEM	NO	NO	NO	2,45,46,47

POMACENTRIDAE	Pomacentrus	emarginatus	ICP	1160	9	18.4	8	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	grammorhynchus	ICP	6200	9	16.4	10	NO	DEM	NO	NO	NO	46,47
POMACENTRIDAE	Pomacentrus	lepidogenys	ICP	10627	9	20	11	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	moluccensis	ICP	9770	9	19.17	13	YES	DEM	NO	NO	NO	2,6,15,20,46,47,PS
POMACENTRIDAE	Pomacentrus	nagasakiensis	ICP	10470	10	22.35	32	YES	DEM	NO	YES	NO	3,45
POMACENTRIDAE	Pomacentrus	pavo	ICP	17127	8	26.24	15	YES	DEM	NO	YES	NO	45,46,47,PS
POMACENTRIDAE	Pomacentrus	philippinus	ICP	11770	10	16	11	YES	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	reidi	ICP	5649	9	18	67	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	simsiang	ICP	6740	7	15.8	10	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Pomacentrus	taeniometopon	ICP	4700	12	15.7	8	NO	DEM	NO	YES	NO	47
POMACENTRIDAE	Pomacentrus	vaiuli	ICP	7930	10	21.16	44	NO	DEM	NO	NO	NO	2,46,47
POMACENTRIDAE	Pomacentrus	wardi	ICP	2570	8	21.66	19	NO	DEM	NO	NO	NO	2,6,20,46
POMACENTRIDAE	Pomachromis	richardsoni	ICP	16219	9.5	21.7	10	YES	DEM	NO	NO	NO	9
POMACENTRIDAE	Premnas	biaculeatus	ICP	6800	17	9.2	15	NO	DEM	NO	NO	NO	PS*
POMACENTRIDAE	Pristotis	obtusirostris	ICP	11770	14	25.3	78	YES	DEM	NO	YES	NO	46
POMACENTRIDAE	Stegastes	acapulcoensis	TEP	5484	17	22	14	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	adustus	TA	4199	12	23.8	3	NO	DEM	NO	YES	NO	47
POMACENTRIDAE	Stegastes	apicalis	ICP	2570	15	29.7	4	NO	DEM	NO	NO	NO	46
POMACENTRIDAE	Stegastes	arcifrons	TEP	1200	15	27.55	19	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	baldwini	TEP	8	9	26	4	NO	DEM	NO	NO	NO	34
POMACENTRIDAE	Stegastes	beebei	TEP	1700	15	32.3	4	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	diaencaeus	TA	3900	15	25.72	43	NO	DEM	NO	NO	NO	3,45
POMACENTRIDAE	Stegastes	emeryi	ICP	1344	10	22.6	17	NO	DEM	NO	NO	NO	PS*
POMACENTRIDAE	Stegastes	fasciolatus	ICP	21680	15	29.95	29	NO	DEM	NO	NO	NO	46,47,PS
POMACENTRIDAE	Stegastes	flavilatus	TEP	5000	10	28.5	9	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	leucorus	TEP	1100	14	32.86	14	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	leucostictus	TA	3900	12	25.29	10	NO	DEM	NO	YES	NO	3,45,47
POMACENTRIDAE	Stegastes	lividus	ICP	500	8.9	25	4	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Stegastes	nigricans	ICP	18700	14	31.68	11	NO	DEM	NO	NO	NO	15,20,46,47,PS
POMACENTRIDAE	Stegastes	partitus	TA	4199	10	31.41	100	NO	DEM	NO	YES	NO	3,45,47,PS
POMACENTRIDAE	Stegastes	planifrons	TA	4199	15	24.1	29	NO	DEM	NO	YES	NO	45,47
POMACENTRIDAE	Stegastes	punctatus	ICP	19720	15	25	12	NO	DEM	NO	NO	NO	47
POMACENTRIDAE	Stegastes	rectifraenum	TEP	1350	9	21.5	9	NO	DEM	NO	NO	NO	34
POMACENTRIDAE	Stegastes	redemptus	TEP	1000	12	27.65	14	NO	DEM	NO	NO	NO	34,47
POMACENTRIDAE	Stegastes	xanthurus	TA	4199	12	24.5	30	NO	DEM	NO	YES	NO	45,47,PS
POMACENTRIDAE	Teixeirichthys	jordani	ICP	13160	14	25.3	16	YES	DEM	NO	YES	NO	46
PRIACANTHIDAE	Heteropriacanthus	cruentatus	TA	12481	51	32.8	297	YES	PEL	YES	NO	NO	PS*
PSEUDOCHROMIDAE	Pseudochromis	quinquedentatus	ICP	3682	9.5	61	40	NO	DEM	NO	YES	NO	3
PTEREOLOTRIDAE	Ptereleotris	calliura	TA	1600	12.5	22.5	45	NO	DEM	NO	YES	NO	PS*
SCORPAENIDAE	Pterois	radiata	ICP	20629	18	40	29	NO	PEL	YES	NO	NO	PS*
SCORPAENIDAE	Pterois	volitans	ICP	11992	38	26.2	53	NO	PEL	YES	YES	NO	49
SCORPAENIDAE	Scorpaena	inermis	TA	4199	11	22	72	NO	PEL	YES	YES	NO	PS*
SCORPAENIDAE	Scorpaena	plumieri	TA	10861	45	21	59	NO	PEL	YES	YES	NO	PS*
SCORPAENIDAE	Scorpaenodes	caribbaeus	TA	10002	12	33	18	NO	PEL	YES	NO	NO	PS*
SCORPAENIDAE	Scorpaenodes	guamensis	ICP	19720	12.5	32.4	5	NO	PEL	YES	NO	NO	PS*
SCORPAENIDAE	Scorpaenopsis	diabolus	ICP	21011	23.4	29.8	69	NO	PEL	YES	YES	NO	PS*
SERRANIDAE	Diplectrum	formosum	TA	10861	30	17.2	79	NO	PEL	NO	YES	NO	PS*
SERRANIDAE	Grammistes	sexlineatus	ICP	19720	30	42	129	NO	PEL	YES	NO	NO	PS*
SERRANIDAE	Hypoplectrus	puella	TA	4091	15	19.1	20	NO	PEL	NO	YES	NO	PS*
SERRANIDAE	Pseudanthias	pascalus	ICP	9651	20	26	55	YES	PEL	NO	NO	NO	2
SERRANIDAE	Pseudogramma	polyacantha	ICP	20329	8.6	32.3	14	NO	PEL	YES	NO	NO	PS*
SERRANIDAE	Pseudogramma	xanthum	ICP	4592	4.1	30.5	40	NO	PEL	YES	NO	NO	PS*
SERRANIDAE	Rypticus	saponaceus	TA	11400	35	40	61	NO	PEL	YES	YES	NO	10
SERRANIDAE	Serranus	baldwini	TA	9501	7.4	23.6	79	NO	PEL	NO	YES	NO	PS*
SERRANIDAE	Serranus	tigrinus	TA	4199	12.3	18.2	40	NO	PEL	NO	YES	NO	PS*
SIGANIDAE	Siganus	canaliculatus	ICP	10841	29	27.5	47	YES	PEL	NO	YES	NO	16
SIGANIDAE	Siganus	doliatus	ICP	6880	25	23.9	4	NO	PEL	NO	NO	NO	PS*

SIGANIDAE	Siganus	fuscescens	ICP	8666	32	19.2	49	YES	PEL	NO	YES	NO	PS*
SIGANIDAE	Siganus	lineatus	ICP	10395	43	33	24	YES	PEL	NO	YES	NO	16
SIGANIDAE	Siganus	rivulatus	ICP	3609	27	39	29	YES	PEL	NO	NO	NO	PS*
SIGANIDAE	Siganus	spinus	ICP	14637	24	22	49	YES	PEL	NO	YES	NO	53
SIGANIDAE	Siganus	vermiculatus	ICP	11262	37	23	5	YES	PEL	NO	YES	NO	16
SIGANIDAE	Siganus	vulpinus	ICP	9651	25	23.5	29	NO	PEL	NO	NO	NO	2
SPARIDAE	Acanthopagrus	latus	ICP	11281	50	33.7	49	YES	PEL	NO	YES	NO	54
SPARIDAE	Archosargus	rhomboidalis	TA	10373	33	21	29	NO	PEL	NO	YES	NO	30
SPARIDAE	Boops	boops	TA	10642	36	16.7	350	YES	PEL	NO	YES	NO	7
SPARIDAE	Diplodus	puntazzo	TA	9115	60	32.7	150	YES	PEL	NO	YES	NO	7
SPARIDAE	Oblada	melanura	TA	13077	34	16	30	YES	PEL	NO	YES	NO	7
SPARIDAE	Pagrus	pagrus	TA	13439	90	38	250	NO	PEL	NO	YES	NO	7
SPARIDAE	Sarpa	salpa	TA	11400	51	31.5	65	YES	PEL	NO	YES	NO	7
SPARIDAE	Spondyliosoma	cantharus	TA	13077	60	35.85	295	YES	PEL	NO	YES	NO	7
SYNODONTIDAE	Synodus	saurus	TA	15875	40	19	400	NO	PEL	NO	YES	NO	PS*
SYNODONTIDAE	Synodus	variegatus	ICP	21500	28	42	118	NO	PEL	NO	YES	NO	PS*
TETRAODONTIDAE	Arothron	hispidus	ICP	27631	48	40.8	47	NO	PEL	NO	YES	YES	PS*
TETRAODONTIDAE	Canthigaster	valentini	ICP	21500	10	18	54	NO	PEL	NO	NO	NO	PS*
TRIPTERYGIIDAE	Axoclinus	nigricaudus	TEP	998	4.5	18	3	NO	DEM	NO	NO	NO	12
TRIPTERYGIIDAE	Enneapterygius	atriceps	ICP	2100	2.6	30	22	NO	DEM	NO	NO	NO	56
ZANCLIDAE	Zanclus	cornutus	ICP	27631	23	57.9	179	NO	PEL	NO	NO	YES	2,PS

Appendix 1. References in Table S1

1. L. A. Rocha, A. L. Bass, D. R. Robertson, B. W. Bowen, Adult habitat preferences, larval dispersal, and the comparative phylogeography of three Atlantic surgeonfishes (Teleostei : Acanthuridae). *Mol Ecol* **11**, 243 (2002).

2. E. B. Brothers, R. E. Thresher, in *The ecology of coral reefs,* M. L. Reaka, Ed. (US Department of Commerce, Washington, D.C, 1985), pp. 53–69.

3. D. T. Wilson, M. I. McCormick, Microstructure of settlement-marks in the otoliths of tropical reef fishes. *Mar Biol* **134**, 29 (1999).

4. D. C. Lou, Growth in juvenile *Scarus rivulatus* and *Ctenochaetus binotatus*: a comparison of families Scaridae and Acanthuridae. *J Fish Biol* **42**, 15 (1993).

5. S. D. Job, D. R. Bellwood, Light sensitivity in larval fishes: Implications for vertical zonation in the pelagic zone. *Limnol Oceanogr* **45**, 362 (2000).

6. E. B. Brothers, D. M. Williams, P. F. Sale, Length of larval life in twelve families of fishes at "One Tree Lagoon", Great Barrier Reef, Australia. *Mar Biol* **76**, 319 (1983).

7. E. Macpherson, N. Raventos, Relationship between pelagic larval duration and geographic distribution of Mediterranean littoral fishes. *Mar Ecol Prog Ser* **327**, 257 (2006).

8. Soeparno, Y. Nakamura, T. Shibuno, K. Yamaoka, Relationship between pelagic larval duration and abundance of tropical fishes on temperate coasts of Japan. *J Fish Biol* **80**, 346 (2012).

9. T. Ishihara, K. Tachihara, Pelagic Larval Duration and Settlement Size of Apogonidae, Labridae, Scaridae, and Tripterygiidae Species in a Coral Lagoon of Okinawa Island, Southern Japan. *Pac Sci* **65**, 87 (2011).

10. B. W. Bowen, A. L. Bass, A. Muss, J. Carlin, D. R. Robertson, Phylogeography of two Atlantic squirrelfishes (Family Holocentridae): exploring

links between pelagic larval duration and population connectivity. *Mar Biol* **149**, 899 (2006).

11. D. R. Robertson, Extreme variation in settlement of the Caribbean triggerfish *Balistes vetula* in Panama. *Copeia* **1988**, 698 (1988).

12. C. Riginos, B. C. Victor, Larval spatial distributions and other early life-history characteristics predict genetic differentiation in eastern Pacific blennioid fishes. *P Roy Soc B-Biol Sci* **268**, 1931 (2001).

13. R. Beldade, T. Pedro, E. J. Goncalves, Pelagic larval duration of 10 temperate cryptobenthic fishes. *J Fish Biol* **71**, 376 (2007).

14. M. J. Shulman, What can population genetics tell us about dispersal and biogeographic history of coral-reef fishes? *Aust J Ecol* **23**, 216 (1998).

15. F. Bonhomme, S. Planes, Some evolutionary arguments about what maintains the pelagic interval in reef fishes. *Environ Biol Fish* **59**, 365 (2000).

16. R. Froese, D. Pauly. (2012).

17. D. J. Booth, K. Parkinson, Pelagic larval duration is similar across 23 degrees of latitude for two species of butterflyfish (Chaetodontidae) in eastern Australia. *Coral Reefs* **30**, 1071 (2011).

18. A. J. Fowler, Description, interpretation and use of the microstructure of otoliths from juvenile butterflyfishes (family Chaetodontidae). *Mar Biol* **102**, 167 (1989).

19. G. R. Almany, M. L. Berumen, S. R. Thorrold, S. Planes, G. P. Jones, Local replenishment of coral reef fish populations in a marine reserve. *Science* **316**, 742 (2007).

20. L. K. Bay, K. Buechler, M. Gagliano, M. J. Caley, Intraspecific variation in the pelagic larval duration of tropical reef fishes. *J Fish Biol* **68**, 1206 (2006).

21. D. J. Shafer, University of Hawaii (1998).

22. S. Sponaugle, R. K. Cowen, Larval durations and recruitment patterns of two Caribbean gobies (Gobiidae): contrasting early-life histories in demersal spawners. *Mar Biol* **120**, 133 (1994).

23. B. C. Victor *et al.*, The larval, juvenile, and adult stages of the Caribbean goby, *Coryphopterus kuna* (Teleostei: Gobiidae): a reef fish with a pelagic larval duration longer than the post-settlement lifespan. *Zootaxa*, 53 (2010).

24. M. S. Taylor, M. E. Hellberg, Genetic evidence for local retention of pelagic larvae in a Caribbean reef fish. *Science* **299**, 107 (2003).

25. A. L. Shanks, B. A. Grantham, M. H. Carr, Propagule dispersal distance and the size and spacing of marine reserves. *Ecol Appl* **13**, S159 (2003).

26. M. A. Steele, The relative importance of processes affecting recruitment of two temperate reef fishes. *Ecology* **78**, 129 (1997).

27. R. S. Waples, R. H. Rosenblatt, Patterns of larval drift in southern California (USA) marine shore fishes inferred from allozyme data. *Fishery Bulletin* **85**, 1 (1987).

28. R. Winterbottom, K. M. Alofs, A. Marseu, Life span, growth and mortality in the western Pacific goby *Trimma benjamini*, and comparisons with *T. nasa*. *Environ Biol Fish* **91**, 295 (2011).

29. R. Winterbottom, L. Southcott, Short lifespan and high mortality in the western Pacific coral reef goby *Trimma nasa*. *Mar Ecol Prog Ser* **366**, 203 (2008).

30. E. D. Houde, Comparative growth, mortality, and energetics of marine fish larvae: temperature and implied latitudinal effects. *Fishery Bulletin* **87**, 471 (1989).

31. K. C. Lindeman, R. Pugliese, G. T. Waugh, J. S. Ault, Developmental patterns within a multispecies reef fishery: Management applications for essential fish habitats and protected areas. *B Mar Sci* **66**, 929 (2000).

32. J. C. Tyler, G. D. Johnson, E. B. Brothers, D. M. Tyler, C. L. Smith, Comparative early-life histories of Western Atlantic squirrelfishes (Holocentridae): age and settlement of rhynchichthys, meeki, and juvenile stages. *B Mar Sci* **53**, 1126 (1993).

33. B. C. Victor, Duration of the planktonic larval stage of one hundred species of Pacific and Atlantic wrasses (family Labridae). *Mar Biol* **90**, 317 (1986).

34. B. C. Victor, G. M. Wellington, Endemism and the pelagic larval duration of reef fishes in the eastern Pacific Ocean. *Mar Ecol-Prog Ser* **205**, 241 (2000).

35. E. T. Schultz, R. K. Cowen, Recruitment of coral-reef fishes to Bermuda - local retention or long-distance transport. *Mar Ecol Prog Ser* **109**, 15 (1994).

36. F. A. Zapata, P. A. Herron, Pelagic larval duration and geographic distribution of tropical eastern Pacific snappers (Pisces : Lutjanidae). *Mar Ecol Prog Ser* **230**, 295 (2002).

37. O. Aburto-Oropeza, I. Dominguez-Guerrero, J. Cota-Nieto, T. Plomozo-Lugo, Recruitment and ontogenetic habitat shifts of the yellow snapper (*Lutjanus argentiventris*) in the Gulf of California. *Mar Biol* **156**, 2461 (2009).

38. J. R. Rooker, A. M. Landry, B. W. Geary, J. A. Harper, Assessment of a shell bank and associated substrates as nursery habitat of postsettlement red snapper. *Estuar Coast Shelf S* **59**, 653 (2004).

39. H. B. Harrison *et al.*, Larval export from marine reserves and the recruitment benefit for fish and fisheries. *Curr Biol* **22**, 1023 (2012).

40. B. C. Victor, R. Hanner, M. Shivji, J. Hyde, C. Caldow, Identification of the larval and juvenile stages of the Cubera Snapper, *Lutjanus cyanopterus*, using DNA barcoding. *Zootaxa*, 24 (2009).

41. R. J. Allman, C. B. Grimes, Temporal and spatial dynamics of spawning, settlement, and growth of gray snapper (*Lutjanus griseus*) from the West Florida shelf as determined from otolith microstructures. *Fishery Bulletin* **100**, 391 (2002).

42. J. Ben-David, J. P. Kritzer, Early life history and settlement of the slender filefish, *Monacanthus tuckeri* (Monacanthidae), at Calabash Caye, Turneffe Atoll, Belize. *Environ Biol Fish* **73**, 275 (2005).

43. M. I. McCormick, Variability in age and size at settlement of the tropical goatfish *Upeneus tragula* (Mullidae) in the Northern Great-Barrier-Reef Lagoon. *Mar Ecol Prog Ser* **103**, 1 (1994).

44. R. E. Thresher, E. B. Brothers, Reproductive ecology and biogeography of Indo-west Pacific angelfishes (Pisces: Pomacanthidae). *Evolution* **39**, 878 (1985).

45. R. E. Thresher, E. B. Brothers, Evidence of intra and inter-oceanic regional differences in the early life history of reef-associated fishes. *Mar Ecol Prog Ser* **57**, 187 (1989).

46. R. E. Thresher, P. L. Colin, L. J. Bell, Planktonic duration, distribution and population structure of western and central Pacific damselfishes (Pomacentridae). *Copeia* **1989**, 420 (1989).

47. G. M. Wellington, B. C. Victor, Planktonic larval duration of one hundred species of Pacific and Atlantic damselfishes (Pomacentridae). *Mar Biol* **101**, 557 (1989).

48. B. S. Green, R. Fisher, Temperature influences swimming speed, growth and larval duration in coral reef fish larvae. *J Exp Mar Biol Ecol* **299**, 115 (2004).

49. D. W. Ahrenholz, J. A. Morris, Larval duration of the lionfish, *Pterois volitans* along the Bahamian Archipelago. *Environ Biol Fish* **88**, 305 (2010).

50. M. R. Lara, J. Schull, D. L. Jones, R. J. Allman, Early life history stages of goliath grouper *Epinephelus itajara* (Pisces: Epinephelidae) from Ten Thousand Islands, Florida. *Endang Species Res* **7**, 221 (2009).

51. P. L. Colin, W. A. Laroche, E. B. Brothers, Ingress and settlement in the Nassau grouper, *Epinephelus striatus* (Pisces: Serranidae), with relationship to spawning occurrence. *B Mar Sci* **60**, 656 (1997).

52. P. Keener, G. D. Johnson, B. W. Stender, E. B. Brothers, H. R. Beatty, Ingress of postlarval gag, *Mycteroperca microlepis* (Pisces: Serranidae), through a South Carolina barrier island inlet. *B Mar Sci* **42**, 376 (1988).