Biological information for appropriate management of endemic fish species at Lord Howe Island

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NON-TECHNICAL SUMMARY

Biological information for appropriate management of endemic fish species at Lord Howe Island

The community of Lord Howe Island harvests seafood from surrounding waters for consumption by islanders and island visitors and the sport of fishing is an important component of tourism at the island. The harvest of two species, Doubleheader wrasse (*Coris bulbifrons*) and bluefish (*Girella cyanea*), from Lord Howe Island waters is of particular interest because those species are not harvested elsewhere in NSW. The NSW general bag limit of 20 individuals applies to these species and there are no size limits imposed them. The community of Lord Howe Island may, however, seek to provide further protection to these species beyond the measures in NSW Fisheries regulations, either by common agreement or through the Marine Park planning process. However, before any changes to the management of these species occurs, basic biological information on age and growth of these species is needed. This project provides some of that information.

Fishing at Lord Howe Island is done by charter fishing operators who take groups on fishing trips in addition to many individuals and tourists who fish in a wide variety of locations and times. In this project, to minimise the cost of obtaining material for estimating age and growth of these fish, the fishers of Lord Howe Island were asked to retain the frames of fish they had caught for later collection. This project provided some of the resources needed to provide a regular pick-up of fish frames and their subsequent processing.

Fish frames were dissected on the island and the otoliths (bones from the fishes' inner ear) were retained for processing in Sydney by NSW Fisheries. These otoliths have a structure much like the rings used to age trees and when they are thinly sliced and viewed with a microscope, the rings can be counted to provide an estimate of the age of the fish. That age estimate, coupled with the size of the fish, can be used to show the growth of the fish, an indication of productivity.

This project provided preliminary estimates of the age and growth of the bluefish and doubleheader, in order to inform the community at Lord Howe Island in any decisions regulating the harvest of these two species. We found that both species could live to a considerable age; over 40 years for bluefish and more than 20 years for doubleheader wrasse. The small number of doubleheader captured during the study means it is likely that a larger sample would contain some fish of a greater maximum age. Both species had relatively steady growth in their early life and small numbers of larger fish were found across a wide range of ages indicating slow growth for most older fish.

The growth rate of bluefish was sufficiently well described by this study to estimate an appropriate size at first capture (i.e. a size limit) based on the rate of change in growth rate over time and broad estimates of the likely rate of mortality of wild bluefish. The suggested minimum size for bluefish estimated from the yield per recruit was about 30 cm but it is important to note that use of a minimum size is only one of a range of measures that could provide equivalent protection for this species.

This project also collected material from a range of other species commonly caught by fishers at Lord Howe Island. These included silver trevally (*Pseudocaranx dentex*), redfish (*Centroberyx* spp.) and rosy jobfish (a tropical snapper, *Pristipomoide*s spp.). There were interesting results from all of these collections. The growth of the silver trevally from Lord Howe Island is much faster than from the same species from coastal NSW. It may be a result of the environment at the island or it may be that the species actually differ. The rosy jobfish seems likely to be two species, not one and the redfish is not *Centroberyx affinis*, the species from coastal NSW but an undescribed species of *Centroberyx*. All three of these popular species were long-lived, the oldest found among the redfish at 59 years and individuals in both other species found in their 30's.

1. BACKGROUND

This project aimed to involve the local community in collecting biological information on two main table fish that are utilised only on Lord Howe Island. These species are uncommon elsewhere and hence unregulated by NSW. The LHI Marine Advisory Committee (MAC), which provides community input regarding marine management to the Lord Howe Island Board, have recommended that the Board seek to regulate these tablefish species. This project has collected initial biological information on these species, which will assist the LHI community in developing appropriate management for these fish species.

2. OBJECTIVES

Long term objectives (after three years)

1. To ensure appropriate and sustainable management of double-header wrasse and bluefish through informed community response and understanding of the biology of these species.
2. To engender support from the Lord Howe Island community for appropriate fisheries management through involvement in data collection, dissemination of information and integration into management regime.
3. To improve understanding of silver trevally, rosy jobfish and redfish by gathering information and biological material from the limited fisheries for these species at Lord Howe Island over a long period.

Short term objectives (to be achieved in three years or less)

1. To provide preliminary estimates of growth and age composition of double-header wrasse and bluefish caught at Lord Howe Island
2. To inform the fishing community at Lord Howe Island about growth and longevity of these species and promote community involvement and discussion of appropriate sustainable management.

3. METHODS

The objectives of the program and the need for volunteers from the fishing community was advertised in *The Signal* (the Island newsletter) and through a public meeting at the Island Hall. Volunteers generally offered to retain frames of fish caught in their freezer until collection by project staff could be arranged. In the case of large specimens (silver trevally and rosy jobfish could reach over 80 cm and some kingfish were more than 1.2 m) the fish was sometimes measured fresh and only the fishes' head stored frozen. In other cases, fishes lengths were measured from thawed frames.

The part-time project staff on the Island collected frozen fish frames as needed and dissected otoliths. The otoliths were cleaned in fresh water and stored dry in paper envelopes. At NSW Fisheries' labs in Sydney, the otoliths were mounted in clear resin, and transversely sectioned through the focus or core with a dual-blade lapidary saw to a thickness of about 0.35 mm. These thin slices of otolith were lightly polished and mounted on a standard microscope slide under a cover slip. Viewing of otolith sections used reflected light on a compound microscope fitted to a camera and image processing system for immediate viewing of specimen images.

The opaque zones in the otolith sections were counted once for each specimen and that count was used as the estimate of the fishes' age, in years. Opaque zones are thought to form annually, in winter or spring (Beckman and Wilson, 1995; Fowler, 1995) but their use without studies to validate the periodicity of the banding pattern must proceed with caution (Campana, 2001).

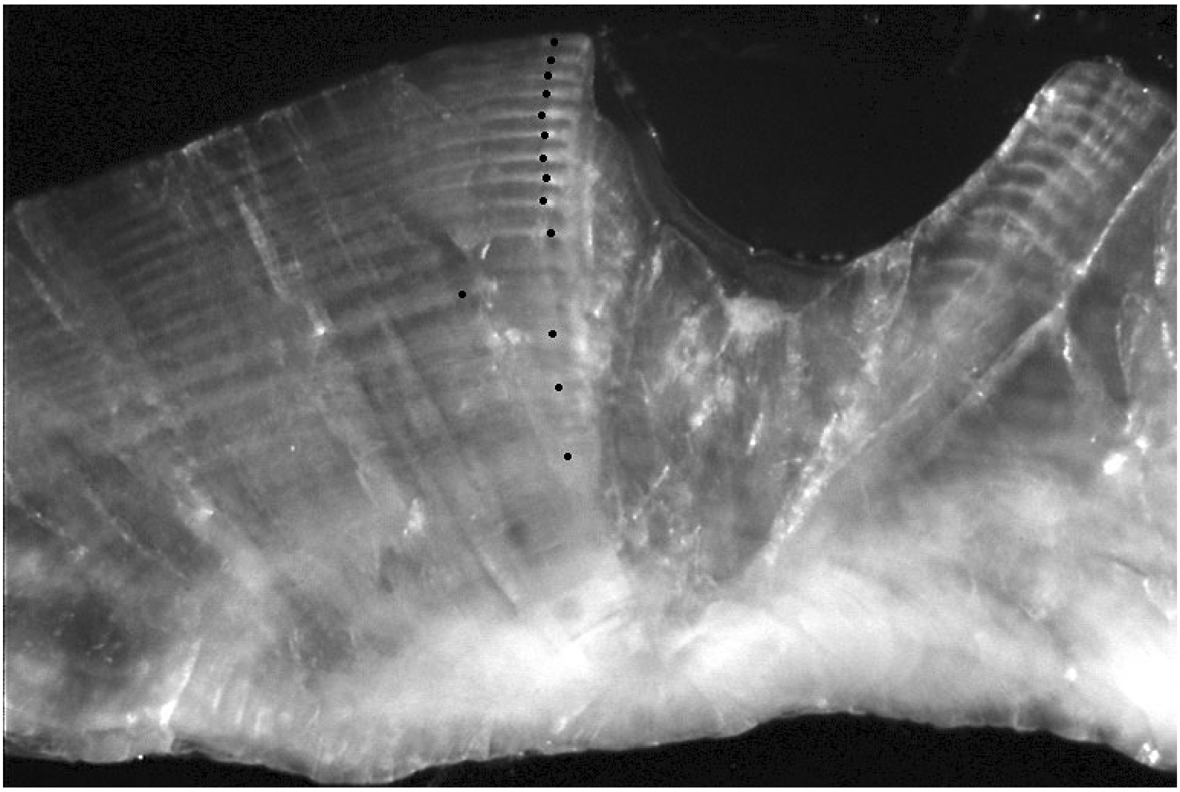

Figure 1. Image of transverse section of bluefish otolith. Each of the black dots indicates an opaque zone, formed in each (14) winter/spring of the fishes' life.

Growth in bluefish was modelled using the von Bertalanffy, three parameter model, fit using the solver in Microsoft Excel. That growth model was used in a yield per recruit analysis modified to allow age-based estimates of growth and mortality (Quinn II and Deriso, 1999). The length-weight relationship used in the yield calculations came from fish captured at Middleton reef during 1992 (K. Clements, Victoria University, Wellington NZ, personal communication). The purpose of the yield per recruit analysis was to examine the likely relationship between productivity from growth and mortality from fishing and natural causes. The instantaneous rate of natural mortality used in this analysis were M = 0.05, 0.1, and 0.15 (or about 5% to 15% per annum).

4. RESULTS

Collections commenced in February 2000 and continued for approximately two years. A summary of the number of fish processed and summary information for each species is presented in Table 1. It is very important to note that the collection of material for this study may not be representative of landings on Lord Howe Island as a whole. For example, fishers who contributed to this study may have fished in a way that was not representative of the "average" Island fisher. If some types of fishers are not properly represented in the sample collected here, then these average sizes and ages may not be representative. It is therefore important to treat information such as the summary in Table 1 with caution.

The average length of the fish collected in this project would be considered large compared to other NSW commercial and recreational fisheries for the same species. For example, the average size of kingfish caught by anglers in the 1995-96 study by Steffe *et al.* (1996) was about 60 cm, compared to the 87 cm average size in this study (Table 1). Similarly, the size of silver trevally regularly landed on Lord Howe Island is nearly 20 cm larger than those landed by the fishery for that species on the NSW coast (Rowling and Raines, 2000). Similar comparisons for bluefish and doubleheader wrasse cannot be made because of the lack of any comparable fishery elsewhere.

Table 1. Summary of information on fish aged. Lengths are given in cm (fork length).

Species	Yellowtail kingfish	Bluefish	Doubleheader wrasse	Rosy jobfish	Silver trevally	Redfish
Number aged	130	95	17	111	76	9
Average length	87	32	53	49	49	37
Size range	43-146	22-52	43-65	29-86	31-88	26-42
Maximum age	21	41	21	39	33	59

The growth of yellowtail kingfish collected at Lord Howe Island was similar to the growth found for that species on the NSW coast (Stewart *et al.*, 2001, Figure 2). Even if the collection of kingfish was not representative of overall landings, this would not affect the conclusion that growth was similar. If growth rates of kingfish from Lord Howe Island were different from kingfish elsewhere, that would support the idea of localised populations of kingfish. Similar growth rates does not preclude the possibility of local populations of kingfish, however it does add support to the data on kingfish movement (Gillanders *et al.*, 2001) that suggests large-scale movement and mixing of this species.

The rosy jobfish collected in this study separate themselves clearly into two groups based on differences in growth (Figure 2). There was a group of fish that rarely exceeded 45 cm fork length, even at more than 20 years of age. The second group of fish were generally at least 25 cm larger at the same age. This study did not collect information on the sex of fish caught but sexual dimorphism is not described in the genus *Pristipomoides* (www.fishbase.org) and the magnitude of the differences shown between the two groups of jobfish would be extremely unusual if they could be sex-related differences in the same species. It seems much more likely that there are two species being landed as rosy jobfish at Lord Howe Island, and that they are similar enough to not be easily separated.

The Department of Primary Industries in Queensland (W. Sumpton, personal communication) has identified two species of rosy jobfish in the deepwater line fishery from that state. They have tentatively identified their two species as *Pristipomoides filamentosus and Pristipomoides sieboldi*. The key that lists distinguishing features has been provided to the Lord Howe Island Board but the most useful features for separating the two require inserting a finger down the throat of the fish to feel for pharegeal teeth. This may not be an easy feature for fishers in the general community to identify the two species.

The other striking feature of the ages of rosy jobfish collected in this project was the lack of certain age groups in the catch of both species (Figure 2). For example, there were no fish caught of age 4 to 7 or age 12 to 14 and the general distribution of ages is clumped. This could be a symptom of sporadic recruitment events, where some years pass between successful recruitment periods. The data could in fact be more clumped than shown here if age readings are imprecise and a large recruitment of, for example, 18 year old fish results in increment counts ranging from 16 to 20 (Richards *et al.*, 1992). No measure of the precision of age estimates was made in this study but repeated readings could have an expected CV of between 5% and 10% (Campana 2001).

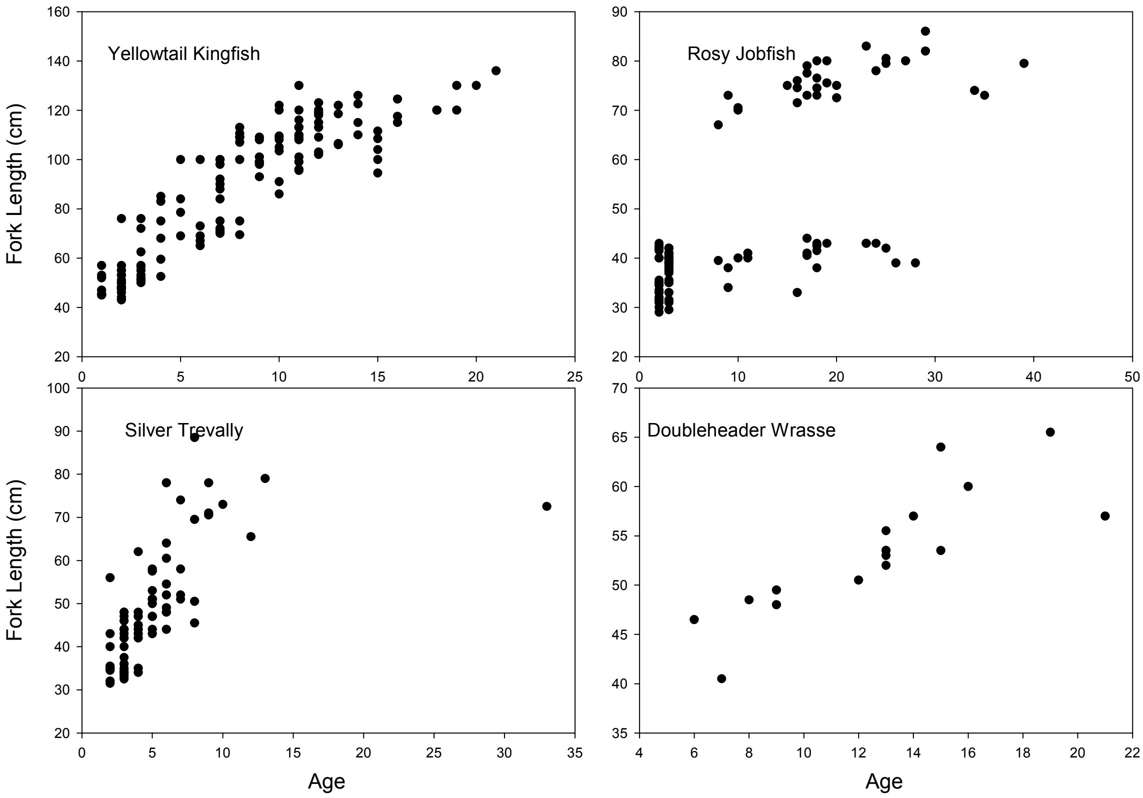

Figure 2. Plot of size and age for four species caught by Lord Howe Island fishers. Please note that each plot has axis scales different from the others.

The growth of silver trevally captured at Lord Howe Island was dramatically different from that found in a recent study on the NSW Coast (Rowling and Raines, 2000). For example, the average size of 5 year old silver trevally from Lord Howe Island was about 50 cm FL but an animal of the same age from coastal NSW had an average size of about 29 cm (Rowling and Raines, 2000). The authors of the coastal study viewed a subset of trevally otoliths from Lord Howe Island and agreed with the interpretation shown here. The growth rate of silver trevally from LHI is so different from that found in coastal fish, it is possible that silver trevally at Lord Howe Island are not *Pseudocaranx dentex*, but some other species. It was beyond the scope of this project to make that determination.

The small number of doubleheader wrasse available to this study means the results presented could change with an additional, larger sample. The fish that were aged showed an increase in size with age for all ages sampled. This suggests that the range of sizes may have been limited by the small sample.

Most of the bluefish catch contributed to this study were between 25 and 35 cm in length (Figure 3). Only a handful of fish over 40 were aged but the oldest of these was estimated to be 41 years old. The best fitting growth curve is shown in Figure 3, however the two fish over 30 years old will exert considerable leverage on the curve, which could change with the collection of more old bluefish.

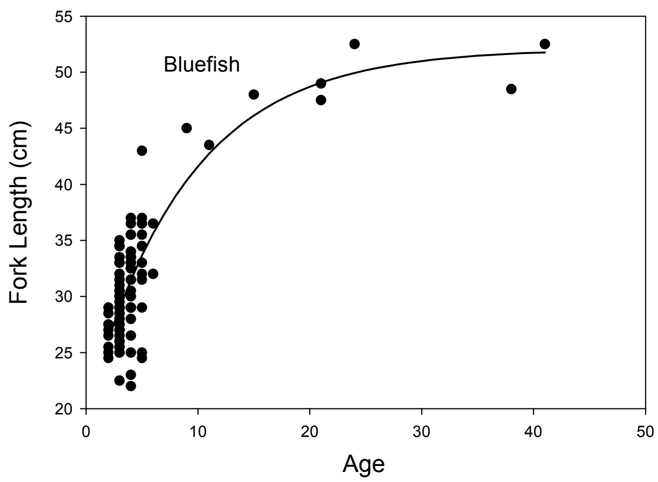

Figure 3. Size and age of bluefish from Lord Howe Island with von Bertalanffy growth model fitted (shown as black line). Parameters of this growth model are L_{inf} – 52.09 cm, K = 0.113 and t_0 = -4.1.

The growth curve for bluefish was used to estimate yield per recruit at three plausible levels of natural mortality (M), 0.05, 0.10 and 0.15 (Figure 4). The mortality rate caused by fishing bluefish is not known and is most likely low and of the same order as natural mortality (0.05 to 0.15). However, it is possible that populations at Lord Howe Island are small and that fishing mortality could be higher, at least at some times or places. For the two scenarios where natural mortality is lowest, there are only small difference in yield to be gained from setting different harvest sizes when fishing mortality is low. However, if fishing mortality is greater than about 0.15, then the different possible minimum harvest sizes do have a large difference in yield (Figure 4). In general, it is most conservative to assume fishing and natural mortality rates are at the high end of the plausible range. The third frame in Figure 4 shows the scenario where natural mortality is 0.15. At that rate of M, the best yields at a similar F are from a minimum size of 30 cm (300 mm). Given the size range of the bluefish landed in this study, a 30 cm size limit would have eliminated all two and most three year old fish from the catch. If a minimum size was considered to be an appropriate means of managing bluefish harvest at Lord Howe Island, a 30 cm size would seem an appropriate compromise in terms of the catch structure and hypothetical yield benefits.

This approach to assisting the determination of a minimum harvest size only relates to estimates of growth and mortality. In theory, the size of first capture can be used to maximise the benefits of the rapid growth of young fish while minimising the ultimate effects of natural mortality on overall production. No consideration is given to reproductive output, the other common factor often used in determining minimum harvest sizes. However, as fish mature, there is a theoretical shift in resources away from growth, into reproduction. The point when growth rates slow is commonly associated with the best harvest size from the yield perspective, so yield-based minimum harvest sizes are often appropriate from a reproductive point of view as well.

There were only 9 redfish aged as part of this study but among them were some fish of considerable age, including one of approximately 59 years. The size of the few redfish sampled in this study differed greatly to those generally landed in the mainland commercial coastal fishery in NSW. Redfish species other than *Centroberyx affinis*, occur around seamounts and other locations in New Zealand. Samples of redfish from Lord Howe Island were sent to the CSIRO seafood genetics laboratory, in Hobart for analysis. It is clear that the redfish at Lord Howe Island is not *Centroberyx affinis*, but it is not clear what species of *Centroberyx* it is (Gordon Yearsly, CSIRO Hobart, personal communication).

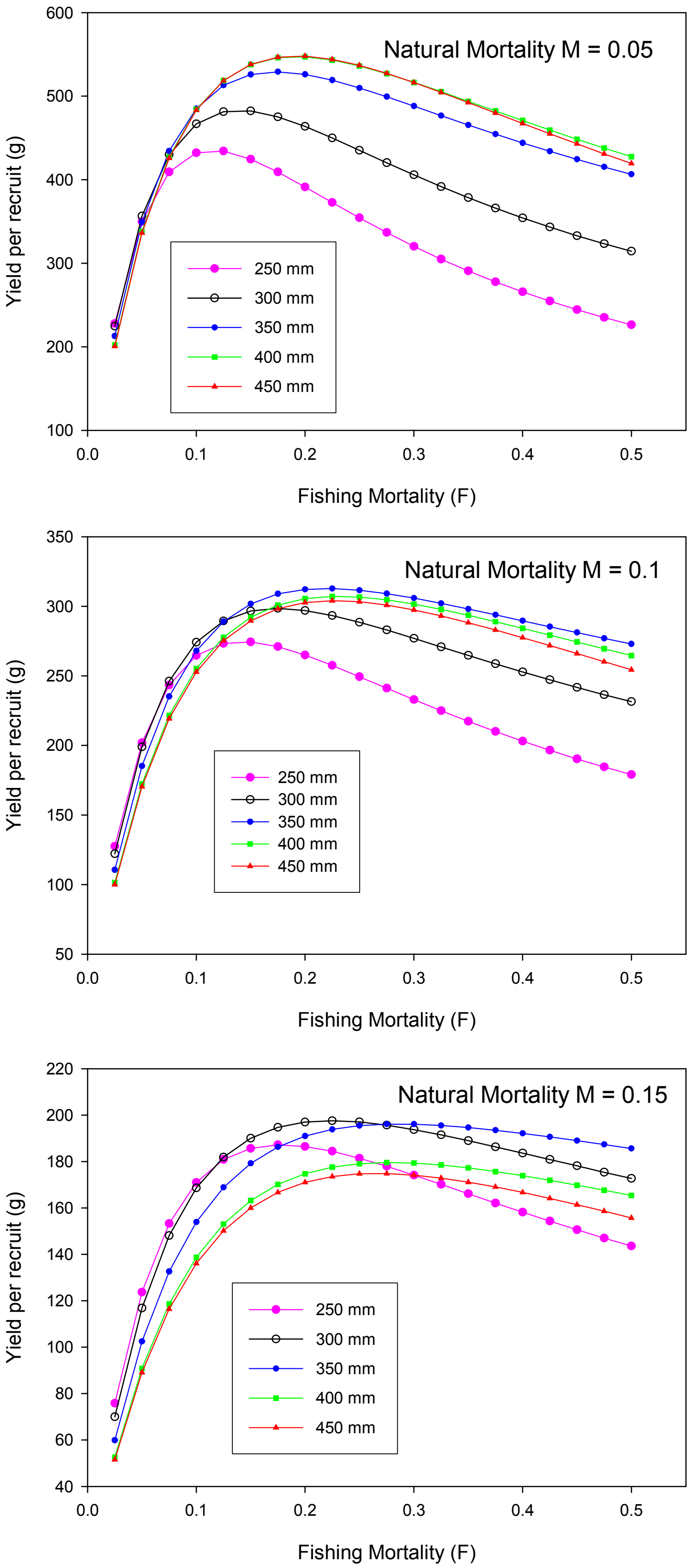

Figure 4. Yield per recruit plotted against fishing mortality for bluefish using three plausible levels of natural mortality. Yield is shown in grams per recruit and that axis on the three figures is plotted in different scales. The five lines in each plot represent yield at a different harvest size (in fork length).

5. SUMMARY

This study has provided preliminary age and growth information on some species that are commonly caught at Lord Howe Island. It is likely, but uncertain, that the mortality caused by fishing is relatively low. However, some of the species popular with islanders are long-lived and more likely to be vulnerable to fishing pressure. The age composition of the rosy jobfish group suggests sporadic recruitment, which would increase the risk of depletion by fishing. The application of this information will aid the Island community in determining how best to regulate the harvest of these fishery resources and in the Marine Park planning process.

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