REPORT OF SESSION ON CULTURED BAITFISH SPECIES

Chairman : Richard S. Shomura
Rapporteur: Robert T. B. Iversen

A. References

Ref/3, Ref/6, Ref/7, Ref/10, Ref/11, WP/Gen/7, WP/Gen/13, WP/Gen 14(new), WP/CB/1, WP/CB/2, WP/CB/4, WP/CB/5, WP/CB/6, WP/CB/7, WP/CB/8, WP/BT/1.

B. Discussion

It was emphasized the results of this session should be recommendations and priorities for subsequent action in the further development of cultured baitfishes. Such guidelines, it was pointed out, are particularly needed by funding agencies such as Sea Grant, which has programs geared to applied research with a short-term payoff. It was recognized that many problems are of a long range nature; thus the overall development of cultured tuna baitfish must be considered on both a short range (i.e. 1-2 years) and long range basis. The fact that there is no single solution to the use of cultured baitfish which will solve the problems of all areas was repeatedly noted. Problems differ markedly from area to area, especially regarding such factors as the availability of land and fresh water. Several members of the group suggested studies on the economics of culture be initiated immediately and carried out on a continuing basis. The discussion of the results of field experiments to date brought out the fact that the design of field experiments needs to be critically reviewed, particularly the sample size necessary to obtain

a clear answer to the question of the effectiveness of the bait at sea. In this regard it was strongly emphasized by Dr. Rothschild that an analysis of the fishing power of the various bait species accompany the examination of the problem of critical design of field trial experiments.

It was also noted that a continuing search for other candidates for baitfish culture be carried out by the various agencies. An inherent dilemma that is generated by the constraints imposed by the finances available may be involved in field testing. On the one hand, field tests should have an adequate sample size, but on the other hand the funds available may make such controlled testing difficult, particularly if the fishing vessel is not under charter.

It was pointed out that short range objectives might be best met by starting with a species that has been previously studied, has shown some promise, and which would not require extensive funding, and which should produce answers within a year or so. In this regard, the choice of species for further immediate testing should probably concentrate on species that most closely resemble the baits traditionally used.

The problem of acceptance of new baitfishes by the fishermen was repeatedly emphasized and the need for extension service activities to complement field and economic studies may be a critical factor.

C. Criteria for culture

Mr. Martin reviewed his report (WP/CB/7) which discusses the general requirements for a species suitable for pond culture. It should: 1) have a high reproductive potential, 2) spawn readily in ponds, 3) obtain food low on the food chain, 4) be readily handled and transported, 5) be euryhaline, 6) lack spines. It was pointed out that even though a species at this time may be less hardy than another (e.g., threadfin shad vs. tilapia), hardiness may develop as experience is gained in culture. Mr. Martin pointed out that when the golden shiner culture industry first started, shiners were extremely delicate to handle, but with the years a much hardier fish has developed, possibly by selection. The possible benefits of polyculture of a bait species with either another non-piscivorous fish or possibly with a crustacean (e.g., Macrobrachium sp.) should be given very serious consideration because 1) the success or failure of the overall operation may depend on additional income generated by the second species and 2) greater production of the baitfish may be possible under a polyculture regime. It was also noted that for the present, the prudent course may be to start culture activities under a monoculture regime, later working into a polyculture regime. Mr. Martin also pointed out that for some species the use of small ponds may produce more baitfishes than larger ponds, and that the results of preliminary pond culture studies are most likely

underestimates of production, since the standing crops of some species in the wild are sometimes much greater than have resulted from pond culture studies (e.g., threadfin shad).

The general discussion on economics brought out the necessity for a general updating of the costs upon which several of the $/bucket estimates are made, and also for the necessity of refining the estimates in order that better cost comparisons can be made between intensive culture species (e.g., tilapia) and extensive culture species (e.g., golden shiners, threadfin shad).

D. Species review--critical factors

The group then reviewed the principal species that have been cultured or have a promise for culture and which have been tested in the past. These principal factors are summarized in the accompanying table, which considers threadfin shad, tilapia, mollies, golden shiners, and Apogon. The table highlights the fact that for those species about which most is known concerning basic biology, culture potential and preliminary economics, the field tests to date generally have been inclusive, while for Apogon, which is highly accepted bait by Okinawan fishermen in the western Pacific, very little is known about the basic parameters required for culture.

1. Threadfin shad. It was pointed out that threadfin shad may be a suitable candidate for polyculture. It has the advantage of spawning several times during the year and

thermal shock apparently can be used to induce spawning. While the general level of knowledge about pond culture of threadfin shad is rather low, production rates achieved to date can probably be greatly increased. The requirement of large land areas for threadfin shad production was noted as a possible drawback for culture, even on large islands such a in Hawaii. Dr. Kato pointed out, however, that the possibility exists of leasing suitable lands on Maui for $60 per acre per year. The possibility of using existing stocks in Wahiawa Reservoir, Oahu Island, Hawaii, for further field tests brought out the fact that a possible conflict between recreational and commercial interests may exist, since the general public fishes for catfish, bass, tucunare, and tilapia in the reservoir. However, the fact that this reservoir often has fish kills of large amounts of threadfin shad may indicate that the best use of threadfin shad in the reservoir is to selectively harvest considerable quantities during the year. It was brought out by Mr. Iversen that there are at least 5,000 buckets of threadfin shad in Wahiawa Reservoir in any given year. (Notes: Following the workshop Mr. William Devick, Aquatic Biologist, Hawaii State Division of Fish and Game, stated that on the basis of analysis of CPUE data collected by the NMFS in the reservoir during the years 1969-70 the standing crop of bait-sized threadfin shad was estimated to be 10,000 to 20,000 buckets

with the most likely mode at 14,000-17,000 buckets. Also subsequent to the session, the captains of the MV Anela and MV Neptune stated they would accept additional threadfin shad for use as tuna bait. Dr. Kato reported that the Maui Island skipjack tuna vessels MV Orion and Tradewind were also interested in using threadfin shad.)

2. Tilapia. Several members of the group emphasized the fact that tilapia still holds considerable promise as a cultured tuna baitfish, especially in a number of island areas where tilapia are known to be abundant, the results of field tests notwithstanding. Tilapia have been field tested over the years but under widely varying conditions, thus results have been inconclusive. It was acknowledged, however, that tilapia poses a particular problem for additional field tests because of non-acceptance by the fishermen, in which the fact that it does not resemble traditional baits may play a major factor. Also, the costs of gearing up for additional field tests are high since an intensive (i.e., hatchery) operation would probably be needed and tilapia facilities at present do not exist. The hardiness of tilapia and their ease of culture, however, were thought to make tilapia as a good candidate for long-range consideration. In this connection, the very high yield of 13,000 pounds per acre per year of tilapia in a pond operation suggests yields from intensive culture of bait-sized tilapia may be improved.

3. Mollies. It was pointed out that mollies are very easy to culture over a wide variety of environmental conditions (fresh water to 100% sea water) and have excellent potential for intensive culture, the production figure of 18,000 pounds per acre per year being cited. It was pointed out that sharpnosed mollie (Poecilia sphenops) is non-cannibalistic, an important consideration for this group of fishes. The major lack of knowledge for the immediate future for mollies in general concerns their suitability when used at sea. It was noted that the Government of American Samoa has an intensive mollie culture project underway with the goal of producing enough bait for substantial field trials during 1974. The economics of mollie culture, $2.60/bucket at 30,000 buckets production make this species one of the more attractive choices from a financial standpoint.

4. Golden shiners. It was pointed out that the very high availability of golden shiners on the mainland United States and relative low cost per bucket delivered airshipped to Hawaii ($4/pound or $28/bucket) make it a very attractive candidate for further field trials that can be commenced in a relatively short time. The golden shiner industry in the United States covers 27,000 acres of production and the techniques of mass transport are very well known. It was noted that the use of golden shiners requires fresh

water and a closed system aboard skipjack tuna vessels. The difficulties of maintaining close fresh systems over long periods were acknowledged but it was pointed out that for short-term tests (i.e., 1 day) a closed system could be utilized that costs under $50 to install.

5. Apogon. It was pointed out by Mr. Wilson that Apogon have had a wide acceptance by skipjack tuna fishermen in the western Pacific, especially fishermen from Okinawa, who have developed unique catching methods for these species, which hover around coral heads. These methods are labor intensive, however, but since this species is a mouth breeder and is very hardy, Apogon might be raised under intensive culture techniques. It was emphasized that Apogon is a species that would not face a fisherman's acceptance problem in the western Pacific where it is a commonly used baitfish species. It was noted that Apogon warranted further consideration as a cultured baitfish candidate because of its proven record. It was pointed out that many of the principal factors (see table) concerning Apogon are unknown, especially the matter of the fecundity, so that the immediate problem is the investigation of some of the fundamental life history parameters of this species. It was generally agreed that such studies should be initiated as soon as

possible. The usefulness of Apogon in atoll areas, should intensive culture prove successful, was also emphasized.

E. Recommendations

The session participants recommended the following:

1. Conduct a critical analysis of the design of future field tests in order to provide the sample size needed to provide unambiguous answers on the effectiveness of the different bait species when used at sea.
2. Concurrently with the experimental design, determine the fishing power of the various bait species under consideration, using existing data with particular reference to nehu and other Stolephorus sp. as models.
3. Recognizing the fact that there is no one solution to the baitfish problems of all areas, conduct future culture and field testing studies on a variety of species.
4. Recognizing the need for both short range and long range solutions to the tuna baitfish problem, on the short-term basis conduct additional field tests with species that have previously shown promise, specifically golden shiners and threadfin shad. On a short-term basis, initiate a re-evaluation of the economics upon which the present cost estimates of bait production are based, and evaluate the methods of presenting production data on intensive and extensive culture methods so the results are readily comparable.

On a long-term basis, initiate economic studies which evaluate the comparative costs of culturing the different species as further advances in culture techniques become available.

5. Recognizing the fact that Apogon has an existing acceptance as a tuna baitfish, and because of its mouth breeding reproductive method and general hardiness, initiate studies as soon as possible on such critical parameters such as fecundity, in order to provide definitive answers as to whether this species should be further investigated as a bait fish culture species.
6. Recognizing that not all possible candidates for baitfish culture have been considered at this workshop, conduct a continuing search for other candidates.
7. Recognizing the fact that fisherman's acceptance of any new bait may be a formidable obstacle to overcome, conduct baitfish extension activities concurrently with the testing of species that show promising results.

Tuna baitfish culture - Principal factors--Contd.

Item	Species				
	Threadfin shad	Tilapia	Mollies	Golden shiners	Apogon
9. State of the art re mass culture	Not much known	Known	Known	Known	Unknown
10. Field experiments to date	Inconclusive	Inconclusive	Inconclusive	Inconclusive	Satisfactory
11. What needs to be done?	1. Project costs, etc. Wahiawa Reservoir 2. Field test	1. Project proposal 2. Field test	1. Hawaii project proposal 2. Hawaii test 3. American Samoa	1. Project costs, etc. 2. Hawaii test	1. Life history research (fecundity)

Tuna baitfish culture - Principal factors

Item	Species				
	Threadfin shad	Tilapia	Mollies	Golden shiners	Apogon
1. Fecundity	14,000-16,000 eggs per female per year. Multiple spawnings	200-800 eggs per female per year (six times per year. 700-1,000 fry survival per female per year	1,600 per female per year	Unknown	Unknown
2. Hardiness	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
3. Density tolerance	1,000 lb per acre per year (estimated possible)	Present: 8,000-13,000 lb per acre per year. Estimated: 25,000 lb per acre per year	18,000 lb per acre per year	800-1,600 lb per acre per year (one or two crops)	Unknown
4. Appearance re traditional bait	Same	Different	Different	Same	Different
5. Behavior:					
a. Culture	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Unknown
b. Used at sea	Satisfactory, but more tests needed	Satisfactory	Inconclusive	Inconclusive	Satisfactory
6. Ease of culture:					
a. Intensive	Not established	Good	Good	Not established	Unknown
b. Extensive	Good	Good	Good	Good	Unknown
7. Economics	$14 per bucket and 3,660 buckets per acre	$19.58 per bucket with profit; $1.06-1.65 reduced	$2.69 per bucket or $0.45 per lb (@ 30,000 buckets)	$4.00 per lb (air-shipped to Hawaii)	Unknown
8. Polyculture	Unknown	Unknown	Unknown	Unknown	Unknown