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BREEDING AND NURSERY CULTURE OF SEBARAU, Hampala macrolepidota (VAN HASSELT AND KUHL, 1823)

INTAN KHAIRULNISA BINTI ZAHARIN

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By

INTAN KHAIRULNISA BINTI ZAHARIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

August 2015

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DEDICATION

To my deceased parents, Allahyarham Mej Zaharin Bin Dato' Md Zamani and Allahyarhamah Puan Khairani Binti Abdullah who passed away last year and this year, may their gentle souls rest in peace, Amin.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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August 2015

Chairman: **Annie Christianus, PhD**
Faculty: **Agriculture**

Hampala macrolepidota or locally known as sebarau, is a native carp species of Malaysia, yet not a popular fish for aquaculture. This may be due to the lack of seed supply and proper nursery culture technique. This study was aimed to breed *H. macrolepidota* using Ovaprim, to observe its embryonic stages and to determine the effects of different salinity, pH, dietary protein and stocking density on the growth and survival of its fry.

For the first objective, induced breeding of *H. macrolepidota* was carried out with injection of 0.6 and 0.3 ml Ovaprim kg^{-1} female and male, respectively. Results from the induced breeding shows that, *H. macrolepidota* with weight ranged from 180 - 280 g was able to produce 243,418 eggs/kg female. Mean of egg diameter for *H. macrolepidota* was 0.80 mm, while percentage of eggs fertilization was 22 % with majority of the eggs hatched within 24 h after fertilization. Embryonic development of *H. macrolepidota* lasted for about 24 h.

For the second objective, *H. macrolepidota* fry with initial body weight ranged from 0.35 – 3.00 g were used for experiments on salinities and pH for a period of 6 weeks. These experiments were conducted with 4 treatments (0, 5, 10 and 15 ppt) and pH also with 4 treatments (6.0, 6.5, 7.0 and 7.5). In both experiments, growth performance (weight and length increments) was determined through weekly sampling. Meanwhile survival and water quality were monitored throughout the study period. The highest percentages of survival for fry at salinity 0 -10 ppt and pH 6.0 -7.5 were 96.67% and 51.67%, respectively. Statistical analysis showed no significant differences ($p>0.05$) for survival, weight and length increments between all the treatments. The highest body weight and total length value were from salinity 0 ppt with the value of 2.50 g and 6.02 cm. As for pH experiment, there were slight differences for weight and length increments during the first three weeks of culture, however no significant differences

($p>0.05$) were observed toward the end of the experimental period. The highest body weight value, 1.24 g was from pH 7.0 and highest total length of 5.00 cm from pH 6.0. The findings of this study showed that *H. macrolepidota* fry were unable to tolerate salinity above 15 ppt, while able to grow well in water with pH ranged from 6.5 to 7.5.

Finally, the third objective, experiments were conducted for 6 weeks to examine the effects of different dietary protein and stocking densities levels on the growth of *H. macrolepidota* fry with initial body weight ranged from 0.2 – 2.0 g. Dietary protein experiment was conducted with 3 treatments (23, 32 and 42% protein level) and stocking density also with 3 treatments (3, 4 and 5 fry/L water). In both experiments, survival and water quality were monitored throughout the study period and growth performance (weight and length increments) was determined through weekly sampling. For the dietary protein experiment, pellet with 32% protein produced the best growth performance for *H. macrolepidota* fry as compared to pellets containing 23 and 42% protein. Fry fed with pellet containing 23% protein showed the highest percentage of survival (76.67%). While fry fed with 23 and 32% of protein pellet showed significantly higher ($p<0.05$) specific growth rate (SGR) than those fed with 42% of protein. In term of feed conversion ratio (FCR), fry fed with 23% protein pellet showed significantly higher ($p<0.05$) FCR than those fed with 32 and 42% protein content. Fry fed with 32 and 42% showed significantly higher ($p<0.05$) protein efficiency ratio (PER) than those fed with 23% protein. As for proximate composition of the feed, no significant difference ($p>0.05$) were observed for crude fibre, moisture and energy between treatments except for the crude protein, ash and NFE. For lipid, pellet with 23 and 32% of protein showed significantly higher ($p<0.05$) lipid content than pellet with 42% protein content. As for stocking density experiment, 3 fry/L showed the highest percentage of survival (100%). However, there was no significant different ($p>0.05$) between all the treatments. The highest body weight and total length was observed in fry stocked at 5 fry/L. Slight differences were observed in body weight during the second week of culture and in length increments during the first week of culture. However, no significant differences ($p>0.05$) were observed between treatment for the first week (body weight) and towards the end of the experimental period (body weight and total length).

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Sarjana Sains

PEMBIAKAN DAN KULTUR NURSERI IKAN SEBARAU, *Hampala macrolepidota* (VAN HASSELT DAN KUHL, 1823)

Oleh

INTAN KHAIRULNISA BINTI ZAHARIN

Ogos 2015

Pengerusi: **Annie Christianus, PhD**
Fakulti: **Pertanian**

Hampala macrolepidota atau dikenali sebagai sebarau adalah spesis peribumi di Malaysia yang masih tidak begitu popular untuk akuakultur. Ini mungkin kerana kekurangan bekalan benih ikan dan teknik kultur nurserinya. Justeru itu, kajian ini dijalankan dengan tujuan untuk membiak *H. macrolepidota* dengan menggunakan hormon Ovaprim, memerhatikan peringkat embrionya dan untuk menentukan kesan saliniti, pH, protein pemakanan dan kepadatan stok ikan terhadap tumbesaran dan kemandirian fri ikan tersebut.

Untuk objektif pertama, pembiakan aruhan *H. macrolepidota* telah dijalankan dengan suntikan 0.6 ml Ovaprim kg^{-1} bagi betina dan 0.3 ml Ovaprim kg^{-1} bagi jantan. Hasil daripada eksperimen ini menunjukkan, *H. macrolepidota* dengan berat berjulat 180 - 280 g mampu mengeluarkan 243,418 telur/kg daripada seekor induk betina. Purata diameter telur *H. macrolepidota* adalah 0.80 mm, manakala kadar persenyawaan telur adalah 22% dengan kebanyakan telur menetas dalam tempoh 24 jam selepas disenyawakan. Perkembangan embrio *H. macrolepidota* mengambil masa lebih kurang 24 jam.

Untuk objektif kedua, fri *H. macrolepidota* dengan berat badan berjulat 0.35 - 3.00 g telah digunakan untuk eksperimen saliniti dan pH bagi tempoh 6 minggu. Eksperimen saliniti dijalankan dalam 4 rawatan (0, 5, 10 dan 15 ppt) dan eksperimen pH juga dalam empat rawatan (6.0, 6.5, 7.0 dan 7.5). Untuk kedua-dua eksperimen ini, prestasi pertumbuhan (berat dan pertambahan panjang) telah ditentukan melalui pensampelan mingguan. Manakala, kemandirian dan kualiti air dipantau sepanjang tempoh kajian. Peratusan kemandirian fri yang paling tinggi pada saliniti 0 -10 ppt, dan pH 6.0 -7.5, adalah 96.67% dan 51.67% masing-masingnya. Analisis statistik tidak menunjukkan perbezaan ketara ($p>0.05$) untuk kemandirian, berat dan panjang fri antara semua rawatan. Berat badan dan panjang tertinggi yang dicatatkan untuk saliniti adalah pada 0

ppt dengan nilai 2.50 g dan 6.02 cm. Bagi eksperimen pH, terdapat sedikit perbezaan untuk pertambahan berat dan panjang untuk tiga minggu pertama pengkulturan, bagaimanapun tiada perbezaan ketara ($p>0.05$) yang diperolehi di akhir tempoh eksperimen. Berat badan tertinggi adalah pada pH 7.0 dengan nilai 1.24 g dan panjang tertinggi pada pH 6.0 dengan nilai 5.00 cm. Hasil kajian menunjukkan bahawa fri *H. macrolepidota* tidak dapat bertahan pada tahap kemasinan lebih dari 15 ppt, manakala ianya mampu membesar dengan baik dalam julat pH 6.5 hingga 7.5.

Akhir sekali, objektif ketiga, eksperimen dijalankan selama 6 minggu untuk menguji kesan protein pemakanan dan kepadatan stok ke atas tumbesaran fri *H. macrolepidota* dengan berat awal 0.2 – 2.0 g. Protein pemakanan dijalankan untuk 3 rawatan (23, 32 dan 42% paras protein) dan kepadatan stok, juga 3 rawatan (3, 4 dan 5 fri/L air). Dalam kedua-dua eksperimen, kemandirian dan kualiti air dipantau sepanjang tempoh kajian dan prestasi pertumbuhan (berat dan pertambahan panjang) telah ditentukan melalui persampelan mingguan. Untuk eksperimen protein pemakanan, pelet dengan 32% protein menghasilkan tumbesaran yang terbaik untuk fri *H. macrolepidota* berbanding dengan pelet 23 dan 42% protein. Fri yang diberi makan pelet yang mengandungi 23% protein memberikan kemandirian tertinggi (76.67%). Manakala fri yang diberi makan pellet dengan 23 dan 32% protein menunjukkan perbezaan yang ketara ($p<0.05$) untuk kadar pertumbuhan tertentu (SGR) berbanding dengan pelet 42% protein. Untuk kadar pertukaran makanan (FCR), fri yang diberi makan pelet mengandungi protein 23% menunjukkan FCR yang lebih tinggi ($p<0.05$) berbanding dengan pelet yang mengandungi 32 dan 42% protein. Manakala, untuk fri yang diberi makan pelet yang mengandungi 32 dan 42% protein menunjukkan nisbah kecekapan protein (PER) yang ketara lebih tinggi ($p<0.05$) berbanding dengan pelet mengandungi 23% protein. Komposisi proksimat untuk makanan, tidak menunjukkan perbezaan ketara ($p>0.05$) untuk serat mentah, lembapan dan tenaga antara rawatan kecuali untuk protein, abu dan NFE. Untuk lipid pula, pelet yang mengandungi 23 dan 32% protein menunjukkan kandungan lipid yang ketara lebih tinggi ($p<0.05$) berbanding dengan pelet yang mengandungi 42% protein. Untuk eksperimen kepadatan stok, 3 fri/L memberikan peratusan kemandirian tertinggi (100%). Walaubagaimanapun, tiada perbezaan ketara ($p>0.05$) untuk kadar kemandirian untuk semua rawatan. Berat badan dan panjang yang tertinggi adalah pada kepadatan 5 fri/L. Terdapat sedikit perbezaan dalam pertambahan berat badan bagi fri yang dikultur pada minggu kedua dan dalam pertambahan panjang badan fri pada minggu pertama pengkulturan. Walaubagaimanapun, tidak terdapat perbezaan ketara ($p>0.05$) di antara rawatan untuk minggu pertama (berat badan) sehingga ke akhir tempoh ekperimen (berat badan dan panjang badan).

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I certify that a Thesis Examination Committee has met on 24 August 2015 to conduct the final examination of Intan Khairulnisa Binti Zaharin on her thesis entitled "Breeding And Nursery Culture Of Sebarau, *Hampala macrolepidota* (Van Hasselt And Kuhl, 1823)" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
cm	Centimetre
DMRT	Duncan's Multiple Range Test
DOF	Department of Fisheries
FAO	Food and Agricultural Organization
FCR	Feed conversion ratio
g	gram
hr	hour
IM	Intramuscular injection
L	Litre
mL	Millilitre
mm	Millimetre
MTDC	Malaysian Technology Development Corporation
PER	Protein effiency ratio
pH	potential Hydrogen
ppt	part per thousand
SGR	Specific growth rate
TL	Total length
Wt	Weight
˚C	Degree Celsius
%	Percentage

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

1.1.1 Economic Status of Aquaculture

Since 1920's, aquaculture sector has developed rapidly in Malaysia. It started with freshwater then continues with brackish water culture in the late of 1930 (FAO, 2011). However, this sector is small when compared to neighboring countries such as Indonesia and Thailand (Tan, 1998). Limited supplies of suitable fish seed is the main reason why aquaculture potential has not been fully realized in Malaysia.

Fishery sector supplies one of the protein source and at the same time assists in the rural development through creation of employment in Malaysia (Safa, 2004). Fisheries statistic showed that this sector has contributed RM11, 440.31 million to the nation's economy in 2012 compared to 2011 by showing increases of 13.61%. Moreover, production of food fish from the aquaculture sector was 302, 886.32 tonnes with valued at RM2, 559.17 million in 2012. This showed an increase of 5.76 and 7.27% respectively compared to 2011. As for freshwater fish culture, it has contributed of 163,756.81 tonnes valued at RM992.39 million in 2012. The production and value showed an increase of 33.99 and 45.05 % respectively when compared to 122,218.73 tonnes valued at RM684.15 million in 2011. This information indicates that aquaculture sector has potential to become the main industry to contribute to the economy. Furthermore, fishing was listed as a secondary occupation (Keskinen, 2003; Hap *et al.,* 2006).

1.1.2 Hormone Usage in Aquaculture

Some species of fish show an extended breeding season and it is desirable to control the timing to synchronize of the breeding process. The most effective and reliable solution for ensuring the availability of good quality fish seed all the year around and sustainable for the aquaculture industry is through induced breeding. This technique includes the use of synthetic hormones to induce ovulation and spawning of farmed fishes (Viveen *et al*., 1985). Hence, there are few hormone used in aquaculture. For example, culturists utilized carp pituitary (CP) gland, human chorionic gonadotropin (HCG), luteinizing hormone-releasing hormone analogue des-Gly10 [D-Ala6] LHRH Ethylamide (LHRHa), Ovatide and Ovaprim.

Primarily, farmer used carp pituitary (CP) to induce breed fish and it is still widely used especially for the Chinese carps, Indian carps and the common carp *Cyprinus*

carpio (Lam, 1983; Park *et al.,* 1994). HCG has been found to be useful in inducing final maturation of oocytes, and widely used in commercial aquaculture (Mylonas *et al*., 2009; Park *et al*., 1994; Donaldson and Hunter, 1983; Park *et al.,* 1997; Kelly and Kohler, 1994). As for LHRHa, the function of this hormone is to induce final maturation and synchronize ovulation of many commercial fish species (Donaldson and Hunter, 1983; Park *et al*., 1997).

Ovaprim and Ovatide are products which contained salmon gonadotropin releasing hormone analogue (sGnRHa) with a dopamine blocker (Syndel International Inc., 2003). Salmon gonadotropin releasing hormone analogue resulted in successful ovulation of some of cyprinids (Drori *et al*., 1994; Glasser, 2004; Rutaisire and Booth, 2004; Hill *et al*., 2005) and catfishes (Sahoo *et al*., 2007). These hormones are usually administered through intramuscular or intraperitoneal injection. Ovaprim has been used on a various type of fishes for aquaculture production (Mohd-Zaini *et al*., 1994; Ingram *et al*., 2005), research (Pinillos *et al*., 2002; Viveiros *et al*., 2002; Hill *et al*., 2005), veterinary purposes (Yanong *et al*., 2003) and conservation (Van Eenennaam *et al*., 2001; Sarkar *et al*., 2006). Overtime, Ovaprim has proven to be very effective, thus became widely accepted synthetic hormones (Nwokoye *et al*., 2007; Olubiyi *et al*., 2005). Ovaprim also is effective at room temperature and it is more eminent compared to carp pituitary extract in inducing fish to breed (Osman *et al.,* 2012). By using Ovaprim, fertilization and hatching rates are higher and larger size of eggs after hardening process. It's also more conserved than pituitary extract (Surnar *et al.,* 2015).

1.2 Problem Statement

Artificial propagation is an alternative way to increase fry production. It was first elaborated in 1765 and has been distributed to many parts of Europe, America, China, Japan and Israel (Omoniyi *et al*., 2013). During the rainy season in the tropical river system, majority of the fishes breed (Alkins - Koo, 2000; Ballesteros *et al*., 2009), but there are few fish breed during the dry season (Pusey *et al*., 2002; Torres-Mejia & Ramírez-Pinilla, 2008) or throughout the year (Alkins-Koo, 2000). For *Hampala macrolepidota*, spawning may not occur due to several factors, such as physicochemical and environmental conditions (Abidin, 1986). Besides sunlight and temperature, changing of water level cause by the monsoonal rains can damage the spawning time on some species (Schields, 1957; Siddique *et al*., 1976).

Until now, *H. macrolepidota* is the most popular among fish consumer and aquaculturist as ornamental and recreational fishes and also as food fish in Malaysia. However, the presence of its culture is very much limited due to the lack fry supply, which dependant on hatchery productions and wild seed. The production of freshwater fish fry and hatchlings from government hatcheries in Malaysia for 2014 were 12, 797, 586 pieces for fry and 4, 729, 349 pieces for hatchling. While for *H. macrolepidota,* the production of its fry from Aquaculture Extension Centre in Perlok, Jerantut, Pahang has declined from 57, 000 pieces in 2013 (DOF, 2013) to 50, 300 pieces in 2014 (DOF, 2014).

Since this fish is a seasonal species that breed naturally, the production in the hatchery is insufficient and inconsistent. Presently, little information is available on its artificial reproduction (Ambak *et al*., 1982; Rosli, 1987) and culture (Aizam and Ang, 1984). To date, with no documented report on the embryonic development and culture requirements. Therefore, further study should be carried out for the successful breeding, larval rearing and culture of *H. macrolepidota.*

1.3 Objectives

Thus, the objectives of this study were:

1. to induced breed *Hampala macrolepidota* using Ovaprim, observe and describe its embryonic stages;
2. to determine the growth performances of the resulted *H. macrolepidota* fry culture at different salinity and pH;
3. to determine the growth performance of the *H. macrolepidota* fry fed with different dietary protein and cultured at different stocking density

REFERENCES

Abidin, A.Z. (1986). The reproductive biology of a tropical cyprinid *Hampala macrolepidota* (Van Hasselt), from Zoo Negara Lake, Kuala Lumpur, Malaysia. *Journal of Fish Biology*, **29**: 381 - 391.

Abraham, M. (1988). Recent trends in research on induced spawning of fish in aquaculture. *Journal of Applied Ichthyology*, **4**: 49 - 64.

Adebiyi, F.A., Siraj, S.S., Harmin, S.A. and Christianus, A. (2013). Induced spawning of a river catfish *Hemibagrus nemurus*. *Pertanika Journal of Tropical Agriculture Science,* **36 (1)**: 71 - 78.

Ahmad Tajuddin B. Zainuddin (1980a): Pembiakan Ikan (Bahagian Satu). Teknologi Pertanian MARDI I, 75 - 87.

Ahmad Tajuddin B. Zainuddin (1980b): Pembiakan Ikan (Bahagian Dua). Teknologi Pertanian MARDI, **1 (2)**: 96 - 107.

Ahyaudin, B.A. (1993). Aspects of the fecundity of the feral catfish, *Clarias macrocephalus* (Gunther), population obtained from the rice fields used for rice – fish farming, in Malaysia. *Hydrobiologia*, **254**: 81 - 89.

Aizam, Z.A. and Ang, K.J. (1984). Fecundity of ikan sebarau, *Hampala macrolepidota* (Van Hasselt) and its relationship to fish length. *Pertanika*, **7**: 95 - 96.

Aksungur, N., Aksungur, M., Akbulut, B. and Kutlu, I. (2007). Effects of Stocking Density on Growth Performance, Survival and Food Conversion Ratio of Turbot (*Psetta maxima*) in the Net Cages on the Southeastern Coast of the Black Sea. *Turkish Journal of Fisheries and Aquatic Science,* **7**: 147 - 152.

Alabaster, J.S. and Lloyd, R. (1980). Water quality criteria for freshwater fish [in Europe], Butterworths, 297.

Ali, A.B. and Kadir, B.K.A. (1996). The reproductive biology of the cyprinid, *Thynnichthys thynnoides* (Bleeker), in the Chenderoh Reservoir – a small tropical reservoir in Malaysia. Hydrobiologia, **318**: 139-151.

Alkins-Koo, M. (2000). Reproductive timing of fishes in a tropical intermittent stream. *Environmental Biology of Fishes,* **57 (1)**: 49 - 66.

Alok, D., Krishnan, T., Talwar G.P. and Grag, L.C. (1993). Induced spawning of catfish, *Heteropneustes fossilis* (Bloch), using D-Lys6 salmon gonadotropin releasing hormone analogue. *Aquaculture*, **115**: 159 - 167.

Alvarez-Gonzalez, C., Ortiz-Galindo, J.L., Dumas, S., Martinez-Diaz, S., Hernandez-Ceballos, D.E., Grayeb-Del Alamo, T., Moreno-Legoret-ta, M., Pena-Martinez, R. and Civera-Cerecedo, R. (2001). Effect of stocking density on the growth and survival spotted sand bass *Paralabrax maculatofasciatus* larvae in a closed recirculating system. *Journal of the World Aquaculture Soc*iety, **32**: 130 - 137.

Ambak, M.A., Zainal Abidin, A. and Mohsin, A.K.M. (1982). Induced breeding of Ikan Sebarau. *Pertanika*, **5**: 117 - 118.

Andrews, J.W. (1977). Protein requirements. *In:* R.R. Stickney and R.T. Lovell (Ed.), Nutrition and feeding of channel catfish. *Southern Cooperative Series, Bulletin,* **218**: 10 – 13.

Anon., (1989). Annual Fisheries Report, 1988, Fisheries Research Institute, Gelugor, Pulau Pinang, 43.

A.O.A.C. (1990) Official Method of Analysis 15th Edition, Association of Official Analytical Chemists Washington, D. U.S.A.

Azuadi, N.M., Siraj, S.S., Daud, S.K., Christianus, A., Harmin, S.A., Sungan, S. and Britin. R (2013). Induced ovulation, embryonic and larval development of Malaysian Mahseer, *Tor tambroides* (Bleeker, 1854) in captivity. *Asian Journal of Animal and Veterinary Advances 2013*, **8 (6)**: 761 - 774.

Baensch, H.A. and Riehl, R. (1991). Aquarien atlas. Bd. 3. Melle: Mergus, Verlag für Naturund Heimtierkunde, Germany, 1104.

Bahnasawy, M.H. (2009). Effect of dietary protein levels on growth performance and body composition of mono sex Nile tilapia, *Oreochromis niloticus* L reared in fertilized tanks. *Pakistan Journal of Nutrition*, **8**: 674 – 678.

Balarin, J.D. and Haller, R.D. (1982). The intensive culture of tilapia tanks, raceways and cages. In; Muir, J.J.F and Roberts, R.J. (Editors), Recent Advances in Aquaculture. Croom Helm Ltd. London, 265 - 355.

Ballesteros, T.M., Torres-Mejia, M. and Ramírez-Pinilla, M.P. (2009). How does diet influence the reproductive seasonality of tropical freshwater fish? A case study of a characin in a tropical mountain river. Neotropical Ichthyology, **7 (4)**: 693 - 700.

Baras, E., Kestemont, P. and Melard, C. (2003). Effect of stocking density on the dynamics of cannibalism in sibling larvae of *Perca fluviatilis* under controlled conditions. *Aquaculture*, **219**: 241 - 255.

Billard, R., Alagaraswami, K., Peter, R.E. and Breton, B. (1983). Potentialization per le pimozide des effects du LHRHA sur la secretion gonadotrope hypophyaire l'ovulation et la spermiation chez la carpe commune (*Cyprinus carpio*). Comptes Rendus de Academie des Sciences Paris, **296**: 181 - 184.

Billard, R., Bieniarz, K., Popek, W., Epler, P., Breton, B. and Alagarswani, L. (1987). Stimulation of gonadotropin secretion and spermiation in carp by pimozide LHRH-a treatment: effects of dose and time of day. *Aquaculture*, **62**: 161 - 170.

Binohlan, C.B. (2011). *Hampala macrolepidota* Kuhl and Van Hasselt, 1823 *Hampala barb.* Stockholm, Sweden. http://www.fishbase.org/summary/Hampala-macrolepidota.html

Bjørnsson, B. (1994). Effects of stocking density on growth rate of Halibut *Hippoglossus hippoglossus* L. reared in large circular tanks for three years. *Aquaculture*, **123**: 259 – 270.

Boeuf, G., and Payan P. (2001). How should salinity influence fish growth? Comparative Biochemical and Physiology, C, **130**: 411 – 423.

Borcato, F.L., Bazzoli, N. and Sato, Y. (2004). Embryogenesis and larval ontogeny of the Pirugordura, *Leporinus piau* (Fowler) (Pisces, Anostomidae) after induced spawning. *Rev. Bras. Zool.*, **21**: 117 - 122.

Boujard, T., Labbe, L. and Auperin, B. (2002). Feeding behavior, energy expenditure and growth of rainbow trout in relation to stocking density and food accessibility. *Aquaculture Research*, **33**, 1233 - 1242.

Boyd, C.E. (1982). Water quality management for pond fish culture. Elsevier Scientific Publishing Co., New York, NY, 318.

Boyd, C.E. and Pillai, V.K. (1985). Water Quality Management in Aquaculture. *CMFRI Special Publication,* **22**: 1 - 44.

Boyd, C.E. (1997). Practical aspects of chemistry in pond aquaculture. Program Fish-Culture, **59**: 85 – 93.

Boyd, C.E. (1998). Water Quality for Pond Aquaculture. Research and Development Series, **43**: 37. International Center for Aquaculture and Aquatic Environments, Alabama Agricultural Experiment Station, Auburn University, Alabama.

Brown, H.W. and Jewell, M.E. (1926). Further studies on the fishes of an acid lake. *Transaction of the American Microscopical Society*, **45**: 20 - 34. Menasha, Wis.

Brown, E.B. and Gratzek, J.B. (1980). Fish Farming Handbook: Food, Bait, Tropical and Goldfish. Westport, Connection: AVI Publishing Company, 391.

Brzuska, E. and Adamek J. (1999). Artificial spawning of European catfish *Silurus glanis* L.; stimulation of ovulation using LHRH-a, Ovaprim and carp pituitary extract. *Aquaculture Research*, **30**: 59 – 64.

Buttner, J.K., Soderberg, R.W. and Terlizzi, D.E. (1993). An Introduction to Water Chemistry in Freshwater Aquaculture .Northeneastern Regional Aquaculture Center. NRAC Fact Sheet No. 170.

Chand, B.K., Singh, M. K. and Mandal, B. (2011). Studies on the breeding of *Pangasius sutchi* using different inducing agents. *Journal of Applied Aquaculture*, **23**: 32 - 40.

Charles, P.M., Sebastian, S.M, Raj, M.C. and Marian, M.P. (1984). Effect of feeding frequency on growth and food conversion of *Cyprinus carpio* fry. *Aquaculture*, **40**: 293 - 300.

Chaudhuri, H. (1968). Breeding and selection of cultivated warm-water fishes in Asia and the Far East. FAO Fish. Rep., **4 (44)**: 30 - 66.

Chaudhuri, H. (1969). Methods adopted for inducing breeding of fishes. FAO/UNDP Regional Seminar on induced breeding of cultivated fishes Barrackpore, Cuttack and Bombay, India. FRI/IBCF/8, 16.

Cheah, M.S.H. and Lee, C.L. (2000). Induced ovulation of the Australian eel-tailed catfish *Neosiluris ater* (Perugia) with OVAPRIM. *Asian Fisheries Science*, **13**: 87 - 96.

Chen, F.Y., Chow, M. and Sim, B.K. (1969). Induced spawning of the three major Chinese carps in Malacca, Malaysia. *Malaysian Agriculture Journal,* 1, **47 (2)**: 211 - 238.

Chervinski, J. (1984). Salinity tolerance of young catfish, *Clarias lazera* (Burchell) Journal of Fish Biology Volume 25, Issue 2. In: *Journal of Fish Biology,* 147 - 149.

Chezhian, A., Kabilan, N., Suresh Kumar, T. and Senthanilselvan, D. (2010). Impact of chemical factory effluent on the structural changes in gills of estuarine fish, *Mugil cephalus. World Applied Science Journal*, **9 (8)**: 922 - 927.

Chiu, Y.N., Sumagaysay, N.S. and Sastrillo, M.S. (1987). Effect of feeding frequency and feeding rate on the growth and feed efficiency of milkfish (*Chanos chanos*). *Asian Fisheries Science*, **1**: 27 - 31.

Cho, C.Y. (2004). Development of computer models for fish feeding standards and aquaculture waste estimations: a treatise. *In* L.E. Cruz Suarez, D. Ricque Marie, M.G. Nieto López, D. Villarreal, U. Scholz, & M. González, eds. *Avances en Nutricion Acuicola VII* Hermosillo, México, 376 – 394.

Chondar, S.L. (1985). HCG a better substitute for pituitary gland for induced breeding of silver carp on commercial scale. In: Proceedings of the second International conference on warm water aquaculture. Finfish, Hawaii, G.S.A., 521 - 534.

Clemens, H.P. (1968). A review of selection and breeding in the culture of warm-water food fishes in North America. *FAO Fisheries Report*, **4 (44)**, 67 - 80.

Clunie, P., Ryan, T., James, K. and Cant, B. (2002). Implications for rivers from salinity hazards: scoping study. Report to the Murray - Darling Basin Commission, Strategic Investigations and Riverine Program - Project R2003. Department of Natural Resources and Environment, Arthur Rylah Institute, Heidelberg, Victoria. 140 pp. ISBN 0 7311 50228. http://www.nre.vic.gov.au/ari/salinityhazards/

Cowey, C. (1976). Use of synthetic diets and bio-chemical criteria in assessment of nutrients requirements of fish. *Journal of the Fisheries Research Board of Canada*, **33**: 1040 - 1045.

Cowey, C.B., Cooke, D.J., Matty, A.J. and Adron, J.W. (1981). Effects of quantity and quality of dietary protein on certain enzyme activities in rainbow trout. / *Nutrition,* I, **11**: 336 - 345.

Craig, A.W. and Jerome, V.S. (2002). Production of ornamental Aquarium fish, University of Florid, UF. IFAS Extension FAO, 39.

Craig, S.T. and Louis, R.D. (2008). Managing High pH in Freshwater Ponds. Southern Regional Aquaculture Center, Publication 4604, Stoneville, Mississippi, 5.

Craig, S. and Helfrich, L.A. (2009). Understanding Fish Nutrition, Feeds, and Feeding. Cooperative Extension Service, Virginia State University, USA, **420**: 256.

Crim, L.W., Peter, R.E. and Van Der Kraak, G.V. (1987). The use of LHRH analogues in aquaculture, 489 - 498. In: Vickery, B.H. and Nestor Jr, J.J. editors. LHRH and its analog: Contraceptive and therapeutic applications, part 2, MTP Press, Boston, MA.

Cruz, B.M. and Laudencia, I.L. (1977). Preliminary study on the protein requirement of Nile tilapia (*Tilapia niloticus)* fingerlings. *Fisheries Research Journal*, Philippines, **3**: 34 - 35.

Cunningham, W.P., Cunningham, M.A. and Saigo, B.W. (2007). *Environmental Science: A global concern.* (9th ed.) New York, N. Y.: McGraw Hill.

Das, S.K., Bhattacharjya, B.K. and Sarma, K. (1994). Induced spawning and hatching of Tawes, *Puntius javanicus* (Bleeker). *Asian Fisheries Science*. Philippines, **7**: 191 - 194.

Das, P.C., Ayyappan, S. and Jena, J.K. (2006): Haematological changes in the three Indian major carps, *Catla catla* (Hamilton), *Labeo rohita* (Hamilton) and *Cirrhinus mrigala* (Hamilton) exposed to acidic and alkaline water pH. *Aquaculture*, **256**: 80 - 87.

Davidson, A., (1975). Fish and fish dishes of Laos. Imprimerie Nationale Vientiane, 202.

Department of Fisheries Malaysia, (2012). Perangkaan Perikanan Tahun 2012. https://www.dof.gov.my/epms/dof2/resources/user_1/UploadFile/Usahawan%20Perikanan/Sumber/P_Perikanan%202012/Penulisan.pdf

Department of Fisheries Malaysia, (2013). Perangkaan Perikanan Tahun 2013 https://www.dof.gov.my/epms/dof2/resources/user_1/UploadFile/Usahawan%20Perikanan/Sumber/P_Perikanan%202013/Jadual_Hatceri.pdf

Department of Fisheries Malaysia, (2014). Perangkaan Perikanan Tahun 2014. https://www.dof.gov.my/epms/dof2/resources/Perangkaan/Perangkaan%202014/8.Hatceri_.pdf

De Boeck, G., Smet, H. and Blust, R., (2000). The energy metabolism of common carp (*Cyprinus carpio*) when exposed to salt stress: an increase in energy expenditure or effects of starvation? . *Physiological and Biochemical Zoology,* **73**, 102 - 111. DOI: 10.1086/316717 PMID: 10685912.

Dehadrai, P. V. (1986): Carp seed production in India, 33. In May, R.C., Pullin, R.S.V. and Jhingran, V.G. (eds.) Summary report of the Asian Regional Workshop on Carp Hatchery and Nursery Technology, 1-3 February, Manila, Philippines. Asian Development Bank and International Center for Living Aquatic Resources Management, Manila, Philippines.

De Silva, S.S. and Perera, M.K. (1985). Effects of dietary protein levels on growth, food conversion and protein use in young *Tilapia nilotica* at four salinities. *Transaction of the American Fisheries Society*, **114***:* 584 - 589.

Dick, M. (2000). The Encyclopedia of Aquarium fish, David and Charles publishers, Newton, Abbot, Devon TQ 12 4 PU, 8 - 99.

Donaldson, E.M. and Hunter, G.A. (1983). Induced final maturation, ovulation and spermation in cultured fish. In: W.S. Hoar, D.J. Rondall and E.M. Donalson, (Eds.), Fish Physiology. Vol. IX, Part B: Reproduction Academic Press, Orlando, Florida, 351 - 403.

Drori, S., Ofir, M., Sivan, B.L.. and Yaron, Z. (1994). Spawning inductionin common carp (*Cyprinus carpio*) using pituitary extract or GnRH superactive analogue combined with methoclopramide: analysis of hormone profile, progress of oocyte maturation and dependence on temperature. *Aquaculture*, **119**: 393 - 407.

Ellis, M.M. (1937). Detection and measurement of stream pollution. *Bulletin of the Bureau of Fisheries; (United States),* **48**: 365 - 437.

El-Sayed, A.M. (2002). Effect of stocking density and feeding levels on growth and feed effiency of Nile tilapia (*Oreochromis niloticus* L.) fry. *Aquaculture Research*, **33**: 621 -626.

El-Sayed, A.M. (2006). Tilapia Culture in Salt Water: Environmental Requirements, Nutritional Implications and Economic Potentials, 15 – 17. 8th Symposium on Advances in Nutritional Aquaculture, November. Nuevo Leon, Mexico.

Enayati, A., Peyghan, R., Papahn, A.A. and Khadjeh, G.H. (2013). Study on effect of salinity level of water on electrocardiogram and some of blood serum minerals in grass carp, Ctenopharyngodon idella. *Veterinary Research Forum*, **4 (1)**: 49 – 53.

EPA. (2012). pH. In Water: Monitoring and Assessment. Retrieved from http://water.epa.gov/type/rsl/monitoring/vms54.cfm

Eschmeyer, William N., ed. (1998). Catalog of Fishes. Special Publication of the Center for *Biodiversity Research and Information*, no. 1, **1 – 3**: 2905.

FAO, (1996). Artificial Reproduction and pond rearing of the African Catfish (*Clarias gariepinus*). Food and Agricultural Organization of the United Nations. Fisheries and Aquaculture Department, Rome, **4**: 38 - 48.

FAO, (2000). The state of world fisheries and aquaculture. FAO Fisheries Department, 142.

FAO, (2011). Regional review on aquaculture in the Asia-Pacific: trends and prospects (Report NO. 1061/5). Rome & Bangkok: FAO Fisheries and Aquaculture Department, Network of Aquaculture Centres in Asia-Pacific (NACA), 89.

Fishbase, (2014). *Hampala macrolepidota* Kuhl and Van Hasselt 1823. http://www.fishbase.org/summary/4803

Fleming, I.A. and Gross, M.R. (1990). Latitudinal clines: a trade-off between egg number and size in Pacific salmon. *Ecology*, **71**: 1 – 11.

Garr, A.L., Lopez, H., Pierce, R. and Davis, M. (2011). The effect of stocking density and diet on the growth and survival of cultured Florida apple snails, *Pomacea paludosa Aquaculture*, **311**: 139 – 145.

Glasser, F., Mikolajczyk, T., Jalabert, B., Baroiller, J. and Berton, B. (2004). Temperature effects along the reproductive axis during spawning induction of grass carp (*Ctenopharyngodon idella*). *General and Comparative Endocrinology*, **136**: 171 - 179.

Gokcek, C.K. and Akyurt, I. (2007). The effect of stocking density on yield, growth, and feed efficiency of himri barbel (*Barbus luteus*) nursed in cages. *Israeli Journal of Aquaculture-Bamidgeh,* **59**: 99 – 103.

Gupta, S.D., Mohapatra, B.C., Sahoo, S.K. and Verma, D.K. (2002). Breeding response of rohu, *Labeo rohita* induced with different inducing agents. Proceedings of the 6th Indian Fisheries Forum, Asian Fisheries Society (Indian Branch) and Indian Fisheries Association (CIFE) Mumbai. December 17 - 20, 2002.

Haines, T.A. (1981). Acidic precipitation and its consequences for aquatic ecosystems: A review. *Transactions of the American Fisheries Society,* **110**: 669 - 707. DOI: 10.1577/1548-8659.

Hamlin, R.S., Jansi, M. and Vasudhevan, I. (2014). Effect of water quality management fot he larval survival of Blue Gourami, Trichogaster trichopterus. International Journal of Water Research 2014, 2(2): 63 – 66.

Hap, N., Seng, L., and Chuenpagdee, R. (2006). Socioeconomics and livelihood values of Tonle Sap lake fisheries. WorldFish Center and Inland Fisheries Research and Development Institute, Phnom Penh, Cambodia, 24.

Hardjamulia, A., Setiadi, K.E. and Rabegnatar, N.S. (1987). Some biological aspects of the predominant fish species in the Jatiluhur Reservoir, West Java, Indonesia, 98 - 104. In S. De Silva (ed.) Reservoir fishery management and development in Asia. International Development Research Center, Ottawa, Canada.

Hargreaves, J.A. (2006). Photosynthetic suspended-growth systems in aquaculture. *Aquacultural Engineering,* **34**: 344 - 363.

Harvey, B.J. and Hoar, W.S. (1979). The Theory and Practice of Induced Breeding in Fish. IRDC-TX21e, 48.

Harvey, B. and Carolsfeld, J. (1993). Induced breeding in tropical fish culture, 14. International Development Research Centre, Ottawa.

Hasan, M.R. (2001). Nutrition and feeding for sustainable aquaculture development in the third millennium. in: R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery, J.R. Arthur (Eds.) Aquaculture in the Third Millennium. NACA, Bangkok/FAO, Rome/Bangkok, Thailand, 2001, 193 – 219.

Haylor, G.S. (1991). Controlled hatchery production of *Clarias gariepinus* (Burchell, 1822): growth and survival of fry at higher stocking density. *Aquaculture of Fisheries Management*, **22**: 405 – 422.

Haylor, G.S. (1992). Controlled hatchery production of *Clarias gariepinus* (Burchell 1822): An Investigation of tank design and water flow rate appropriate for *Clarias gariepinus* in hatcheries. *Aquaculture of Fisheries Management*, **23**: 649 - 659.

Hickling, C.F. (1966). The artificial inducement of spawning in the grass carp, *Ctenopharyngodon idella* Val. A review. Proc. Indo-Pacific Fish Council, **12 (1l)**: 236 - 243.

Hill, M.T. and Hill, S.A. (1994). Fisheries ecology and hydropower in the lower Mekong River: an evaluation of run-of-the-river projects. Mekong Secretariat, Bangkok, Thailand, 106.

Hill, J.E., Baldwin, J.D., Graves, J.S., Leonard, R., Powell, J.F.F and Watson, C.A. (2005). Preliminary observations of topical gill application of reproductive hormones for induced spawning of a tropical ornamental fish. *North American Journal of Aquaculture,* **67**: 7 – 9.

Hill, J.E., Kilgore, K.H. and Pouder, D.B. (2009). Survey of ovaprim use as a spawning aid in ornamental fishes in the United States as administered through the University of Florida tropical aquaculture Laboratory. *North American Journal of Aquaculture*, **71**: 206 - 209.

Hõbe, H., Wood, C.M. and McMahon, B.R. (1984). Mechanisms of acid-base and ionoregulation in white suckers (*Catostomus commersoni*) in natural soft water. *Journal of Comparative Physiology B,* **154**: 35 - 46.

Holm, J.C., Refstie, T. and Bo, S. (1990). The effect of fish density and feeding regimes on individual growth rate and mortain rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, **89**: 3 - 4.

Hossain, M.A., Toyub, M.A., Islam, M.N. and Islam, M.R. (1994). Effects of species combination on the major and Chinese carps in demonstration ponds under Feni district. *Bangladesh Journal of Agricultural Sc*ience, **21 (2)**: 257 - 266.

Hossain, M.A., Hassan, N., Shah, A.K.M.A. and Hussain, M.G. (2002). Optimum dietary protein requirement of mahseer, *Tor putitora* (Hamilton) fingerlings. *Asian Fisheries Science*, **15**: 203 - 214.

Houssay, B.A. (1930). Accion sexual de la hipofisis en los perces y reptiles. Rev. Soc.Agent. Biol. **6**: 686 - 688.

Huang, W.B. and Chiu, T.S. (1997). Effects of stocking density on survival, growth, size variation, and production of Tilapia fry. *Aquaculture Research*, **28**: 165 - 173.

Imsland, A.K., Foss, A., Conceicao, L.E.C., Dinis, M.T., Delbare, D., Schram, E., Kamstra, A., Rema, P. and White, P. (2003). A review of the culture potential of *Solea solea* and *S. senegalensis*. Reviews in Fish Biology and Fisheries, **13**: 379 – 407.

Ingram, B., Sungan, S., Gooley, G., Sim, S.Y., Tinggi, D. and De Silva, S.S. (2005). Induced spawning, larval development and rearing of two indigenous Malaysian mahseer*, Tor tambroides* and *T. douronensis*. *Aquaculture Research,* **36**: 1001 – 1014.

Irwin, S., Halloran, J.O. and Fitz Gerald, R.O. (1999). Stocking density, growth and growth variation in juvenile turbot (*Scophthalmus maximus*). *Aquaculture*, **178**: 77 - 88.

Jamabo, N.A and Keremah, R.I. (2009). Effects of stocking densities on the growth and survival of the fingerlings of *Clarias gariepinus* (Burchell, 1822). *Journal of Fisheries International,* **4 (4)**: 55 - 57.

Jamilah, B. and Mohd, A.Y. (1993). Changes in bighead carp (*A. nobilis*} stored at ambient temperature. *ASEAN Food Journal,* **8**: 149 – 152.

Jauncey, K. and Rose, B. (1982). A guide to tilapia feeds arid feeding. Institute of Aquaculture, University of Sterling, Scotland, 111.

Johnson, D.S., and Soong, M.H.H. (1965). The fate of introduced freshwater fish in Malaysia. Proc. Int. Congr. Zoo., 16th, 1963, **1**: 246.

Jonsson, N. and Jonsson, B. (1999). Trade off between egg mass and egg number in brown trout. *Journal of Fish Biol*ogy, **55**: 767 - 783.

Jun, Q., Pao, X., Haizhen, W., Ruiwei, L. and Hui, W. (2012). Combined effect of temperature, salinity and density on the growth and feed utilization of Nile tilapia juveniles (*Oreochromis niloticus*). *Aquaculture Research,* **43**: 1344 – 1356.

Kahkesh, F.B., Feshalami, M.Y., Amiri, F., and Nickpey, M. (2010). Effect of Ovaprim, Ovatide, HCG, LHRH-A2, LHRHA2+CPE and Carp Pituitary in Benni (*Barbus sharpeyi*) Artificial Breeding. Global Veterinaria, **5 (4)**: 209 - 214.

Kalbassi, M.R., Lorestani, R. and Maramazi, J.G. (2013). Analysis of saline activator solution effects on sperm quality indices of Barbus sharpeyi by image J software. *Iranian Journal of Fisheries Sciences,* **12**: 357 - 377.

Kamaruddin, I.S., Mustafa-Kamal, A.S., Christianus, A., Daud, S.K., Amin S.M.N., and Yu-Abit, L. (2011). Length-weight relationship and condition factor of three dominant species from the lake Tasik Kenyir, Terengganu, Malaysia. *Journal of Fisheries and Aquatic Sci*ence, **6**: 852 - 856.

Kaushik, S.J. and Medale, F. (1994). Energy requirements, utilization and dietary supply to salmonids. *Aquaculture*, **124**: 81 - 97.

Kaushik, S.J. (1998). Nutritional bioenergetics and estimation of waste production in non-salmonids. *Aquatic Living Resources*, **11 (4)**: 211 - 217.

Kelly, A.M. and Kohler, C.C. (1994). Human chorionic gonadotropin injected in fish degrades metabolically and by cooking. *Journal of The World Aquaculture Society*, **25**: 55 - 57.

Keskinen, M. (2003). The great diversity of livehoods: Socio-economic survey of the Tonle Sap Lake. Water Utilization Program - Modelling of the Flow Regime and Water Quality of the Tonle Sap MRCS/WUP-FIN Project. MRC/Finnish Environment Institute, Phnom Penh, 126.

Khan, M.M.R. and Mollah, M.F.A. (1998). Embryonic and larval development of African catfish, *Clarias gariepinus* (Burchell). *Bangladesh Journal of Fish*eries, **21 (1)**: 91 - 97.

Khattab, Y.A.R., Abdel-Tawwab, M. and Ahmad, M.H. (2004). Effect of protein level and stocking density on growth performance, survival rate, feed utilization and body composition of Nile tilapia fry (*Oreochromis niloticus* L.). In: Bolivar, R, Mair, G. and Fitzsimmons, K. (eds) Proceedings of the Sixth International Symposium on Tilapia in Aquaculture, Manila, Philippines, BFAR, Philippines, 264 - 276.

Kiran, B.R., Shankar Murthy, K. and Venkateshwarlu, M. (2013). A review on induced breeding of cat fishes, murrels and climbing perches in India. Advances in *Applied Science Research*, **4 (4)**: 310 - 323.

Kocabaş, M., and Başçinar, N. (2013). The effect of salinity on spotting features of *Salmo trutta abanticus, S. trutta fario and S. trutta labrax* of cultured brown trout. *Iranian Journal of Fisheries Sciences,* **12**: 723 - 732.

Kottelat, M. (1998). Fishes of the Nam Theun and Xe Bangfai basins, Laos, with diagnoses of twenty-two new species (Teleostei: Cyprinidae, Balitoridae, Cobitidae, Coiidae and Odontobutidae). *Ichthyological Exploration of Freshwaters*, **9**: 1 – 128.

Koumoundouros, G., Divanach, P. and Kentouri, M. (2001). Osteological development of *Dentex dentex* (Osteichthyes: Sparidae): Dorsal anal, paired fins and squamation. Mar. Biol., **138**: 399 - 406.

Kujawa, R., Lach, M., Pol, P., Ptaszkowski, M., Mamcarz, A., Nowosad, J., Furgała-Selezniow, G., Kucharczyk, D. (2016). Influence of water salinity on the survival of embryos and growth of the sichel larvae *Pelecus cultratus* (L.) under controlled conditions. *Aquaculture Research*, DOI: 10.1111/are.12972 (in press).

Kupren, K., Mamcarz, A. and Kucharczyk, D. (2011). Effect of variable and constant thermal conditions on embryonic and early larval development of fish from the genus Leuciscus (Cyprinidae, Teleostei). *Czech Journal of Animal Science*, **56**:70 - 80.

Lam, T.J. (1982). Applications of endocrinology to fish culture. *Canadian Journal of Fisheries and Aquatic Science*, **39**: 111 - 1137.

Lam, T.J. (1983). Environmental influences on gonadal activity in fish. In: Fish Physiology (eds. W.S. Hoar, D.J. Randall and E.M. Donaldson), 65 - 116. Academic Press, London.

Lam, T.J. (1985). Induced spawning in fish. In: Reproduction and culture of milkfish (eds. C.S. Lee and I.C. Liao), 14 - 56. The Oceanic Institute, HI, and Tungkang Marine Laboratory, Taiwan.

Lambert, D. (2001). *Tonle Sap Fisheries: A Case Study on Floodplain Gillnet Fisheries.* Bangkok, Thailand: FAO Regional Officer for Asia and the Pacific, FAO Asia-Pacific Fisheries Commission. RAP Publication 2001, **11**: 113.

Landau, M. (1992). Introduction to Aquaculture. Van Nostrand Reinhold, New York, USA, John Wiley and Sons, Inc, 464.

Larry, W.M. (1996). Water resources Handbooks. Editor-in-Chief, McGraw–Hill, companies, London.

Lawson, T.B., (1995). Fundamentals of Aquaculturel Engineering. New York: Chapman and Hall, 355.

Lim, C., Sukhawongs, S. and Pascual, S.P. (1979). A preliminary study on the protein requirements of *Chanos chanos* (Forskal) fry in a controlled environment. Aquaculture, 17: 195 - 201.

Lin, H-R. and Peter, R.E. (1986). Induction of gonadotropin secretion and ovulation in teleosts using LHRH analogous and catecholaminergic drugs: a review, 667 - 670. *In:* J.L. Maclean, L.B. Dizon and L.V. Hosillos, editors. The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

Lin, Y.W.C.D.M. (1990). Effects of ecological factors on fry of Tilapia sp. *Transactions of Oceanology and Limnology,* **1**: 57 - 63.

Lin, H.R. and Peter, R.E. (1996). Hormones and spawning in fish. *Asian Fisheries Science*, **9**: 21 - 23.

Ling, S.W. (1969). Induced breeding of the grey mullet. *Mugil cephalus*. FAO Fish Culture Bulletin, **1**: 4.

Liong, P.C. (1984). Water quality standards for aquaculture in Malaysia. Jabatan Perikanan, Kementerian Pertanian Malaysia. Risalah Perikanan Bil. **20**: 10.

Liu, K.M. and Chang, W.Y.B. (1992). Bioenergetic modelling of effects of fertilization, stocking density, and spawning on the growth of Nile tilapia (*Oreochromis niloticus*). *Aquaculture and Fisheries Management*, **23**: 291 - 301.

Losordo, T.M., Masser, M.P. and Rakocy, J. (1999). Recirculating Aquaculture Tank Production Systems: A Review of Component Options. SRAC Publication, **453**: 12.

Love, J.D. (1983). The role of hemi iron in the oxidation of lipids in red meat. *Journal of Food Technology,* **37**: 117 – 123.

Lovell, R.T. (1989). Nutrition and Feeding of Fish. Van Nostrand-Reinhold. New York, 260.

Ma, A., Chen, C., Lei, J., Chen, S., Zhuang, Z. and Wang, Y. (2006). Turbot *Scophthalmus maximus*: stocking density on growth, pigmentation and feed conversion. (Abstract) *Chinese Journal of Oceanology and Limnology*, **24 (3)**: 307 - 312.

Manob, T., Khamchal, L. and Sugin, N. (1988). Induced spawning by using HCG produced from urine of pregnancy women. Naga, 6.

Marinasari, R. (2015). Effects of Effort and Water Quality on Productivity (CPUE) of Hampal *(Hampala macrolepidota)* Resources in Jatiluhur Dam, West Java Padjadjaran, Indonesia. ICADS 2015: XIII International Conference on Animal and Dairy Sciences.

Masser, M.P., Rakocy, J. and Losordo, T.M. (1999). Recirculating Aquaculture Tank Production Systems: Management of Recirculating Systems. *SRAC Publication,* **452**: 12.

Matthew, J.R., Kenneth A.W. Jr. and Holt, G.J. (2006). Growth and survival of juvenile cobia, *Rachycentron canadum*, at different salinities in a recirculating aquaculture system. *Aquaculture*, **253**: 398 – 407. Doi: 10.1016/j.aquaculture.2005.08.023.

Mazlum, Y. (2007). Stocking density affects the growth, survival, and cheliped injuries of third instars of narrow-clawed crayfish, *Astacus leptodactylus* Eschscholtz, 1823 juveniles Crustaceana, **80**: 803 – 815.

McFarlane, G.A., King, J.R. and Saunders, M.W. (2002). Preliminary study on the use of neural arches in the age determination of bluntnose sixgill sharks (*Hexanchus griseus*). *Fishery Bulletin*, **100 (4)**: 861 - 864.

McKee, J.E., and Wolf, H.W. (1963). Water quality criteria. Second Edition. Publ. No. 3-A California State Water Resources Control Board, Sacramento, 548.

Mittelmark, J. and Kapuscinski, A. (2008). Induced Reproduction in Fish. Minnesota Sea Grant. University of Minnesota, 9 - 27.

Mohd-Zaini, S., Saadon, K. and Omar, A.B. (1994). Ovaprim: satu teknologi baru pembiakan ikan akuarium. [Ovaprim: a new technology for spawning aquarium fish.] Progressive Fisheries Research Conference, Department of Fisheries, Malaysia, **4**:257 – 260.

Mollah, M.F.A., Taslima, F., Rashid, H., Hossain, Z., Sarowar, M.N., and Khan, M.R.K. (2011). Embryonic and larval development of critically endangered riverine catfish *Rita rita*. *EurAsia Journal of Bioscience*, **5**: 110 - 118.

Molnar, T., Hancz, C., Bodis, M., Muller. T., Bercsenyi, M. and Horn, P. (2004). The effect of the initial stocking density on the growth and survival of the pikeperch fingerling reared under intensive conditions. *Aquaculture Internatinal*, **12**:181 – 189.

Morita, K. and Takashima, Y. (1998). Effect of female size on fecundity and egg size in white-spotted char: Comparison between sea-run and resident forms. *Journal of Fish Biology*, **53**: 1140 - 1142.

Mousa, M.A. (2010). Induced spawning and embryonic development of *Liza ramada* reared in freshwater ponds. *Animal Reproduction Science*, **119**: 115 - 122.

Munro, I.S.R. (1980). In Freshwater Fishes of South-eastern Australia. (R.M. McDowall, .ad.) (A.H. and A.W. Reed Pty. Ltd.: Sydney), 208.

Mylonas, C.C., Fostier, A. and Zanuy, S. (2009). Broodstock management and hormonal manipulation of fish reproduction. *Aquaculture,* **197**: 99 - 136.

Nandeesha, M.C., Rao, K.G., Jayanna, R., Parker, N.C., Varghese, T.J., Keshavanathand, P., and Shetty, H.P.C. (1990). Induced spawning of Indian major carps through single application of Ovaprim. In: Proceedings of The Second Asian Fisheries Forum, Eds., R. Hirano and I. Hanyu. Asian Fisheries Society, Manila, Philippines, 581 - 585.

Nandeesha, M.C., Bhandraswami, G., Patil, J.G., Varghese, T.J., Kamal, S. and Keshavanath P. (1993). Preliminary results on induced spawning of pond varied mahseer, Tor Khudri *Journal of Aquaculture in Tropics*, **8**: 55 - 60.

National Research Council. (1977). Nutrient requirements of warm water fishes. *In:* Nutrient Requirements of Domestic Animals. *National Academic of Science,* **11**: 57.

National Research Council. (1983). Nutrient requirements of warm water fishes. *National Academic of Sciences*, Washington, D.C. Advances in Fish research Vol. 3. Fisheries and fish biology Research, 102.

Ng, W.K., Abdullah, N. and De Silva, S.S. (2008). The dietary protein requirement of the Malaysian mahseer, *Tor tambroides* (Bleeker) and the lack of protein-sparing action by dietary lipid. *Aquaculture*, **284**: 201 - 206.

Nwokoye, C.O., Nwuba, L.A. and Eyo, J.E. (2007). Induced propagation of African clariid catfish, *Heterobranchus bidorsalis* (Geoffrey Saint Hillarie, 1809) using synthetic and homoplastic hormones. *African Journal of Biotechnology,* **6 (23)**: 2687 - 2693.

Ogundiran, M.A., Fawole, O.O., Adewoye, S.O. and Ayandiran, T.A. (2009). Pathologic lesions in the gills of *Clarias gariepinus* exposed to sublethal concentrations of soap and detergent effluents. *Animal Biology*, **3 (5)**: 78 - 82.

Øiestad, V. (1999). Shallow raceways as a compact resource maximizing farming procedure for marine fish species. *Aquaculture*, **30**: 831 - 840.

Okamoto, T., Kurokawa T., Gen, K., Murashita, K., Nomura, K., Kim, S.K., Matsubara, H., Ohta, H. and Tanaka, H. (2009). Influence of salinity on morphological deformities in cultured larvae of Japanese eel, *Anguilla japonica*, at completion of yolk resorption. *Aquaculture,* **293**: 113 – 118.

Olaniyi, C.O and Akinbola, D.O. (2013). Comparative Studies on The Hatchability, Performance and Survival Rate of African Catfish (Clarias gariepinus) Larval Produced: Using Ovaprim and Catfish Pituitary Extract Hormones. *Journal of Biology, Agriculture and Healthcare*, **3**: 57 – 62.

Olubiyi, O.A, Ayinia, O.A., Adeyemo, A.A. (2005). The effects of various doses of ovaprim on reproductive performance of the African catfish *Clarias gariepinus* (Burchell) and *Heterobranchus longifilis* (Valenciennes). *African Journal of Applied Zoology and Environmental Biology*, **7**: 101 - 105.

Omoniyi, I.T., Agbeti, O.T. and Olaoye. O.J. (2013). Fish Production and Management. www.unaab.edu.ng/attachments/463_FIS501%20by% 20ITO.pdf. Retrieved on 21, May, 2014.

ORVWSC (Ohio River Valley Water Sanitation Commission). (1955). Aquatic life water quality criteria: First progress report. Aquatic Life Advisory Committee. Sewage and Industrial Wastes, **27**: 321 - 313.

Osman, M. S., Barua M. P., Rahman M. T., Sarker S. (2012). Induced breeding of *Labeo rohita* using synthetic hormone ovaprim in Bangladesh: An approach to comparison of 3 prescribed amount. *Science and Culture*, **78 (7–8)**: 338 - 342.

Papst, M.H., Dick, T.A., Arnason, A.N. and Engel, C.E. (1992). Effect of rearing density on the early growth and variation in growth of juvenile Arctic charr, *Salvelinus alpinus (L.)*. *Aquaculture and Fisheries Management*, **23**: 41 - 47.

Park, I.S., Kim, H.B., Choi, H.J., Lee, Y.D. and Kang, H.W. (1994). Artificial induction of spawning by human chorionic gonadotropin (HCG) or carp pituitary extract (CPE) in olive flounder, *Paralichthys olivaceus*. *Journal of Aquaculture*, **7**: 89 - 96.

Park, I.S., Chung, E.Y.and Hong, K.P. (1997). Hormonal induction of ovulation in the coho salmon, *Oncorhynchus kisutch*. *Journal of Aquaculture*, **10**: 485 - 486.

Perera, P.A.C.T, Kodithuwakku, K.A.H.T, Sundarabarathy, T.V. and Edirisinghe. U. (2013). Captive Breeding of *Anabas testudineus* (Climbing Perch) under Semi-artificial Conditions for the Mass Production of Fish Seed for Conservation and Aquaculture. *Insight Ecology*, **2**: 8 - 14. DOI: 10.5567/ECOLOGY-IK.2013.8.14.

Peter, R.E., Chang, J.P., Nahorniak, C.S., Omeljaniuk, R.J., Sokolowska, M., Shih, S.R. and Billard, R. (1986). Interaction of catecholamines and sGnRH in regulation of gonadotropin secretion in teleost fish. Recent Progress in Hormone Research, **42**: 513 - 548.

Peter, R.E. (1983a). The brain and neurohormones in teleost reproduction. In: W.S. Hoar, D.J. Randall, and E.M. Donaldson, editors. Fish Physiology Vol IXB Academic Press, New York, 97 - 135.

Peter, R.E. (1983b). Evolution of neurohormonal regulation of reproduction in lower vertebrates. Amer. Zool., **23**: 685 - 695.

Peter, R.E., Lin, H.R. and Van Der Kraak, G. (1988). Induced ovulation and spawning in cultured fresh water fish in China: advanced in application of GnRH analogue and dopamine antagonists. *Aquaculture*, **74**: 1 - 10.

Pillay, T.V.R. (1990). Aquaculture: Principles and practices. Fishing News Book. Blackwell Scientific Publications, Ltd., Oxford, UK, 575.

Philminaq, (2008). Mitigating Impact from Aquaculture in the Philippines. Water Quality Criteria and Standards for Freshwater and Marine Aquaculture. http://www.aquaculture.asia/files/PMNQ%20WQ%20standard%202.pdf. Date visited: July 18, 2011.

Pinillos, M.L., Guijarro, A.I., Delgado, M.J., Hubbard, P.C., Canario, A.V.M., and Scott. A.P. (2002). Production, release and olfactory detection of sex steroids by the tench (*Tinca tinca* L.). *Fish Physiology and Biochemistry*, **26**: 197 – 210.

Piper, R.G. (1986). Fish hatchery management, US Dept. of the Interior, Fish and Wildlife Service, 544. DOI: 10.5962/bhl.title.4038.

Piska, R.S. and Naik, J.K.S. (2007). Fresh water aquaculture Fisheries, II year Paper I (Ed. Ravi Shankar Piska) Intermediate Vocational Course, State Institute of Vocational Education and Board of Intermediate Education. *Asian Journal of Animal Sciences*, **8**: 56 - 64; doi:10.3923/ajas.2014.56.64.

Pouey, J.L.O.F., Piedras, S.R.N, Rocha, C.B., Tavares, R.A. and Santos, J.D.M. (2011). Productive performance of silver catfish, *Rhamdia quelen*, juveniles stocked at different densities. *Ars Veterinaria*, **27**, 241 – 245.

Pusey, B. J., Arthington, A.H., Close, P.G. and Bird, J.R. (2002). Larval fishes in rainforest streams: recruitment and microhabitat use. Proceedings of the Royal Society of Queensland, **110**: 27 - 46.

Rahardjo, M.F. (1977). Kebiasaan Makanan, Pemijahan, Hubungan Panjang- Berat dan Faktor Kondisi Ikan Hampal, *Hampala macrolepidota* (Cuvier & Valenciennes) di Waduk Jatiluhur, Jawa Barat. Fakultas Perikanan, Institut Pertanian Bogor, Bogor, Indonesia. Thesis. Sekolah Pascasarjana. IPB, Bogor, 32.

Rahman, M.R., Rahman, M.A., Khan, M.N. and Hussain, M.G. (2004). Observation on the embryonic and larval development of Silurid catfish, Gulsha (*Mystus cavasius*). *Pakistan Journal of Biology Science,* **7 (6)**: 1070 - 1075.

Rainboth, W.J. (1996). Fishes of the Cambodian Mekong. FAO species identification field guide for fishery purposes. Rome: Food and Agriculture Organization Publication, 265.

Ravi, R. and Manisseri M.K. (2013). The effect of different pH and photoperiod regimens on the survival rate and developmental period of the larvae of *Portunus pelagicus* (Decapoda, Brachyura, Portunidae). *Iranian Journal of Fisheries Sciences*. **12**: 490 - 499.

Rhee, K.S., Dutson, T.R. and Smith, G.C. (1984). Enzymic lipid peroxidation in microsomal fractions from beef skeletal muscle. *Journal of Food Science,* **49**: 675 – 689.

Rideout, R.M. and Burton, M.P.M. (2000). Peculiarities in ovarian structure leading to multiple-year delays in oogenesis and possible senescence in Atlantic cod (*Gadus morhua*). *Canadian Journal of Zoology*, **78**: 1840 - 1844.

Ridha, M.T. (2006). Comparative study of growth performance of three strains of Nile tilapia, *Oreochromis niloticus*, L. at two stocking densities. *Aquaculture Research,* **37**: 172 - 179.

Riede, K. (2004). Global register of migratory species - from global to regional scales. Final Report of the R&D-Project 808 05 081. Federal Agency for Nature Conservation, Bonn, Germany, 329.

Roberts, T.R., (1993). Artisanal fisheries and fish ecology below the great waterfalls of the Mekong River in southern Laos. *Natural History Bulletin of the Siam Society*, **41**: 31 - 62.

Ronald, D.Z., John, D.M. and Macol, M.S. (1999). Source Water Quality for Aquaculture. Environmentally and Socially Sustainable Development: A Guide for Assessment, Rural Development, Washington, D.C. The World Bank, 23764, 1 - 59.

Rosli, A.Z. (1987). Pembiakan aruhan ikan sebarau *Hampala macrolepidota* (Van Hasselt) dengan menggunakan ekstrak pituitari, human chorionic gonadotropin dan kombinasi antara kedua-duanya. Laporan Projek FFPSS 1987.

Rottmann, R.W., Shireman, J.V. and Chapman, F.A. (1991). Introduction to hormone-induced spawning of fish. U.S. Department of Agriculture, Southern Regional Aquaculture Center, Publication 421, Stoneville, Mississippi, 3.

Rutaisire, J. and Booth, A.J. (2004). Induced ovulation, spawning, egg incubation and hatching of the cyprinid fish *Labeo victorianus* in captivity. *Journal of the World Aquaculture Society*, **35**: 383 - 391.

Ryan, J.R.J., Esa, Y.B. (2006). Phylogenetic analysis of *Hampala* Fishes (Subfamily Cyprininae) in Malaysia inferred from partial mitochondrial cytochrome *b* DNA sequences. Zool. Sci., **23**: 893 - 901.

Safa, M.S. (2004). Potential fishery industry activities and financial aspects of East Malaysian marine fisheries. Selangor: Universiti Putra Malaysia. Paper retrieved from http://mpra.ub.uni- muenchen.de/10887/1/Safa.pdf on March 8, 2009.

Sahin, T. (2001). Larval rearing of the Black Sea turbot, *Scophthalmus maximus* (Linnaeus, 1758), under laboratory conditions. *Turkish Journal of Zoology*, **25**: 447 - 452.

Sahoo, S.K., Giri, S.S. and Sahu, A.K. (2004). Induced breeding of *Clarias batrachus* (Linn.): effect of different doses of Ovatide on breeding performance and egg quality. In: National Seminar on Responsible Fisheries and Aquaculture, Orissa, India, 12-13 February, 2004, 2.

Sahoo, S.K., Giri, S.S. and Sahu, A.K. (2005). Effect on breeding performance and egg quality of *Clarias batrachus* (Linn.) at various doses of ovatide during spawning induction. *Asian Fisheries Science,* **18**: 77 - 83.

Sahoo, S.K., S.S. Giri, Chandra, S. and Sahu, A.K. (2007). Effect of Ovaprim doses and latency period on induced spawning of *Clarias batrachus*: Observation on larval deformity. *Indian Journal of Experimental Biology*, **45 (10)**: 920 - 922.

Sahoo, S.K., Giri, S.S and Chandra, S. (2008). Induced Spawning of *Clarias batrachus* (Linn.): Effect of Ovaprim Doses and Latency Periods on the Weight of Stripped Eggs and Ovary. *Asian Fisheries Science,* **21 (3)**: 333 – 338.

Sampaio, L.A. and Bianchini, A. (2002). Salinity effects on osmoregulation and growth of the euryhaline flounder *Paralichthys orbignyanus. Journal of Experimental Marine Biology and Ecology,* **269**: 187 – 196.

Sampath, K. (1984). Preliminary report on the effect of feeding frequency in *Channa striatus*. *Aquaculture*, **40**: 301 - 306.

Santiago, C.B., Banes-Aldaba, M. and London, M.A. (1982). Dietary crude protein requirement of *Tilapia nilotica* Fry. Kalikasan Philipp. *Journal of Biology*, **11**: 255 -265.

Sarkar, S.K. (2002). Fresh water fish culture. Days publishing House Delhi, **1**: 9 - 239.

Sarkar, U. K., Deepak, P. K., Negi, R. S., Singh, S. and Kapoor, D. (2006). Captive breeding of endangered fish *Chitala chitala* (Hamilton-Buchanan) for species conservation and sustainable utilization. *Biodiversity and Conservation*, **15**: 3579 – 3589.

Schields, J.T. (1957). Experimental control of carp reproduction through water draw - downs in Fort Rendall reservoir, South Dakota. *Transactions of American Fisheries Society*, **87**: 23 - 33.

Setiadi, K.E., Rabegnatar, W.S. and Hardjamulia, A. (1987). Some biological aspects of the predominant fish species in the jatiluhur reservoir, West Java, Indonesia. Proceedings of the Workshop on Reservoir Fishery Management and Development in Asia, November 23-28, 1987, Kathmandu, Nepal, 98 - 104.

Sharma, K., Yadara, N.K. and Jindal, M. (2010). Effects of different doses of ovatide on the breeding performance of *Clarias batrachus* Linn. Livestock Research for Rural Development. 22 (4) Notes to Authors. www.Irrd.orgIrrd22/4/shar22069htm. Oct, 2011.

Shehadeh, Z.H. (1969). Induced breeding of the grey mullet, *Mugil cephalus*. FAO Fish Culture Bulletin, **1**: 3 - 4.

Shields, R.J., Brown, N.P. and Bromage, N.R. (1997). Blastomere morphology as a predictive measure of fish egg viability. *Aquaculture*, **155**: 1-12.

Shinkafi, B.A. and Ilesanmi, B.D. (2014). Effect of Varying Doses of Ovatide on the Breeding Performance of African Catfish (*Clarias gariepinus* Burchell, 1822) in Sokoto, North-western Nigeria. *Asian Journal of Animal Sciences*, **8**: 56 - 64. Doi: 10.3923/ajas.2014.56.64.

Siddique, A.Q., Hatterjee, C.A. and Khan, A.A. (1976). Reproductive biology of the carp, *Labeo bata* (Ham.) from the river Kali, India. *Aquaculture,* **7**: 181 - 191.

Siddiqui, A.Q., Howloder, M.S. and Adam, A.A. (1988). Effects of dietary protein levels on growth, feed conversion and protein utilization in fry and young Nile tilapia *{Oreochromis niloticus). Aquaculture*, **70**: 63 - 73.

Singh, R.K., Chavan, S.L., Desai, A.S. and Khandagale, P.A. (2008). Influence of dietary protein levels and water temperature on growth, body composition and nutrient utilization of *Cirrhinus mrigala* (Hamilton, 1822) fry. *Journal of Thermal Biology*, **33**: 20 – 26.

Sorphea, S., Lundh, T., Preston, T.R. and Borin, K. (2010). Effect of stocking densities and feed supplements on the growth performance of tilapia (*Oreochromis* spp.) raised in ponds and in the paddy field. *Livestock Research for Rural Development*, **22**: 227.

Southworth, B.E., Engle, C.R. and Ruebush, K. (2009). The effect of understocking density of channel catfish stockers in multiple-batch production. *Journal of Applied Aquaculture*, **21**: 21 – 30.

Srisuwahtach, V. and Trangtrongpiros, M. (1985). Induced breeding and larval rearing of *Clarias macrocephalus*. Regional Lead Centre in Thailand at NIFI, Bangkok 15.

Stickney R.R., (1994). Principles of Aquaculture. John Willey & Sons, New York, New York USA, 520.

Stumm, W. and Morgan, J.J. (1981). Aquatic chemistry: An introduction emphasizing chemical equilibriain natural waters. John Wiley and Sons, New York, 131-134, 483 - 487.

Sugunan, W. and Katiha, P. (2004). Impact of stocking density on yield in small reservoirs in andra-pradesh, India. *Fisheries Management Ecology*, **11**: 193 - 202.

Summerfelt, R.C. (1998). Water quality considerations for aquaculture. *Aquaculture Network Information Center (http://aquanics.org*).

Suresh, A.V. and Lin, C.K. (1992). Tilapia culture in saline water: a review. *Aquaculture,* **106**: 201 – 226.

Surnar, S.R., Kamble, A.D., Walse, N.S., Sharma, O.P., Saini, V.P. (2015). Hormone administration with induced spawning of Indian major carp. *International Journal of Fisheries and Aquatic Studies* 2015, **3**: 1 - 4.

Syndel International Inc., (2003). Using Ovaprim to induce spawning in cultured fish. http://www.syndel.com/spawning/using_ovaprim.html

Synudeen, S.S. (2003). Salinity tolerance of *Clarias batrachus*. *Journal of Ecotoxicology and Environmental Monitoring*, **13**: 319 – 320.

Taki, Y. (1974). Fishes of the Lao Mekong Basin. United Stated Agency for International Development Mission to Laos, Agriculture Division, 232.

Taki, Y. and Kawamoto, A. (1977). Differentiation of the Cyprinids, *Hampala macrolepidota* and *H. dispar*. *Japanese Journal of Ichthyology*, **24**: 61 - 65.

Talwar, P.K. and Jhingran, A.G. (1991). Inland fishes of India and adjacent countries. vol 1. A.A. Balkema, Rotterdam, 541.

Tan, C.K. (1998). Overview of aquaculture in Malaysia. In Nagaraj, G. and Singh, T. (eds.) Aquaculture practices in Malaysia. Occasional publication No. 9. Kuala Lumpur: Malaysian Fisheries Society.

Thorpe, J.E., Miles, M.S. and Keay, D.S. (1984). Developmental rate, fecundity and egg size in Atlantic salmon, *Salmo salar* L. *Aquaculture*, **43**: 289 - 305.

Timmons, M.B., Ebeling, J.M., Wheaton, F.W., Summerfelt, S.T. and Vinci, B.J. (2002). Recirculating Aquaculture Systems, 2nd Edition. Cayuga Aqua Ventures, Ithaca, NY 14850, USA, 800. NRAC Publication No. 01-002.

Tiwana, G.S. and Raman, S. (2012). An economic viable approach for induced breeding of *Labeo rohita* by ovatide, ovaprim and carp pituitary extract. *IOSR Journal of Agriculture and Veterinary Science,* **1**: 30 - 32.

Tjahjo, D.W.H. (1985). Studi Pendahuluan Kebiasaan Makanan Ikan Hampal, *Hampala macrolepidota* di Waduk Jatiluhur. In Kartamihardja, E.S., ed., Himpunan Hasil Penelitian Perikanan Perairan Umum (Danau) Tahun 1984-1985. Sub Balai Penelitian Perikanan Air Tawar, Jatiluhur, Indonesia, **IX**: 1 - 3.

Torres-Mejia, M. and Ramírez-Pinilla, M.P. (2008). Dry-season breeding of a characin in a tropical mountain river. Copeia, 2008, **1**: 99 - 104.

Turkowski, K., Kucharczyk, D., Kupren, K., Hakuæ-B3a¿owska, A., Targoñska, K., ¯arski, D. and Kwiatkowski, M. (2008). Economic aspects of the experimental rearing of asp, *Aspius aspius* (L.), ide, *Leuciscus idus* (L.), and dace, *Leuciscus leuciscus* (L.) under controlled conditions – Arch. Pol. Fish., **16**: 397 - 411.

Vaas, K.F., Sachlan, M. and Wiraatmadja, G. (1953). On the ecology and fisheries of some inland waters along rivers Ogan-Komering-in southeast Sumatera. Contributions of the Inland Fisheries Research Station, Bogor, Indonesia, **3**: 1 - 31.

Van Eenennaam, J.P., Webb, M.A.H., Deng, X., Doroshov, S.I., Mayfield, R.B., Cech, J.J., Jr., Hillemeier, D.C. and Wilson, T.E. (2001). Artificial spawning and larval rearing of Klamath River green sturgeon. *Transactions of the American Fisheries Society*, **130**: 159 – 165.

Varsamos, S., Nebel, C., and Charmantier, G. (2005). Ontogeny of osmoregulation in postembryonic fish: a review. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology,* **141**: 401 - 429.

Vidthayanon, C. (2002). Peat swamp fishes of Thailand. Office of Environmental Policy and Planning, Bangkok, Thailand, 136.

Viveen, W.J.A.R., Richter, C.J.J., Van Oordt, P.G.W., Janssen, J.A.L.and Huisman, E.A. (1985). Practical manual for the culture of the African catfish (*Clarias gariepinus).* Section for Research and Technology, Ministry for Development Co-operation, PO Box 20061 2500 EB The Hague The Netherlands, 128.

Viveiros, A.T.M., Fessehaye, Y., Veld, M.T., Schultz, R.W. and Komen, J. (2002). Hand-stripping of semen and semen quality after maturational hormone treatments, in African catfish *Clarias gariepinus*. *Aquaculture*, 213: 373–386.

Von W.H. (1988). Sublethal effects of pollutants on fish eggs and larvae. pp. 253-346. In: W. S. Hoar & D. J. Randall (eds.), *Fish Physiology vol. XIA - The physiology of developing fish*. Academic Press, San Diego, 546.

Wang, K.W. Takeuchi, T. and Watanbe, T. (1985). Effect of dietary protein levels on *growth of Tilapia niloticus. Bulletin of the Japanese Society of Scientific Fisheries*, **51**: 133 - 140. (English Summary).

Watanabe, W.O. and Kuo, C.M. (1985). Observations on the reproductive performance of Nile tilapia (*Oreochromis niloticus*) in laboratory aquaria at various salinities. *Aquaculture,* **49**: 315 – 323.

Watanabe, W.O., Kuo, C.M. and Huang M.C. (1985). Salinity tolerance of Nile tilapia fry (*Oreochromis niloticus*) spawned and hatched at various salinities. *Aquaculture,* **48**: 432 – 442.

Wurts, W.A. and Durborow, R.M. (1992). Interactions of pH, carbon dioxide, alkalinity and hardness in fish ponds, Southern Regional Aquaculture Center Stoneville, Mississippi, SRAC Publication, **469**: 4.

Yamazaki, F. and Donaldson, E.M. (1968). The effects of partially purified salmon pituitary gonadotropin on spermatogenesis, vitellogenesis and ovulation in hypophysectomized goldfish, *Carassius auratus*. Gen. Comp. Endocrinol., **11**: 292 - 299.

Yang, S.D., Liou, C.H., Liu and F.G. (2002). Effects of dietary protein level on growth performance, carcass composition and ammonia excretion in juvenile silver perch (*Bidyanus bidyanu*s). *Aquaculture*, **213**: 363 – 372.

Yanong, R.P.E. (1996). Reproductive management of Freshwater Ornamental Fish, Seminars in Avan and Exotic Pet Medicine, Vol, 5, No 4, October, (1996), 222 - 235.

Yanong, R.P.E., Curtis, E.W., Terrell, S.P. and Case, G. (2003). Atypical presentation of mycobacteriosis in a collection of frogfish (*Antennarius striatus*). *Journal of Zoo and Wildlife Medicine,* **34**: 400 – 407.

Zainudin, M.R.Y. (2005). Assessment of fish community distribution and composition in the Perak River in order to determine biological indicators for freshwater health. M.Sc. Thesis, Universiti Sains, Malaysia.

Zakaria, M.Z., Jalal, K.C.A. and Ambak, M.A. (2000). Length weight relationship and relative condition factor of Sebarau *Hampala macrolepidota* (Van Hasselt) in Kenyir lake Malaysia. *Pakistan Journal of Biological Sciences,* **3 (5)**: 721 - 724.

Żarski, D., Kucharczyk, D., Kwiatkowski, M., Targońska, K., Kupren, K., Krejszeff, S., Jamróz, M., Hakuć-Błazowska, A., Kujawa, R. and Mamcarz, A. (2008). The effect of stocking density on the growth and survival of larval asp, *Aspius aspius* (L.), and European chub, *Leuciscus cephalus* (L.), during rearing under controlled conditions. *Archives of Polish Fisheries*, **16**: 371 - 382.

Zhu, Y.J., Yang, D.G., Chen, J.W., Yi, J.F. and Liu, W.C. (2011). An evaluation of stocking density in the cage culture efficiency of Amur sturgeon *Acipenser schrenckii*. *Journal of Applied Ichthyology,* **27**: 545 – 549.

Zohar, Y. and Mylonas, C.C. (2001.) Endocrine manipulations of spawning in cultured fish: From hormones to genes. *Aquaculture*, **197**: 99 - 136.

Zulkafli, A.R. and Ashhar, A.O. (2000). Fish fauna in Tasik Kenyir. Freshwater Fisheries Research Centre, Batu Berendam, Melaka. Available at: www.fri.gov.my/pppat/kenyirweb/ index.htm

Zweig, R.D., Morton, J.D. and Stemarts, M.M. (1999). Source Water Quality for aquaculture .a Guide for Assessment. Environmentally and Socially Sustainable Development, Rural Development.